Faculty of Computers & Information Technology

A Mobile Application for Diagnosing and Treating Muscular Injuries

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This thesis is submitted as a partial fulfillment of the requirements for the degree of Bachelor of Computers & Information Technology

EELU- Assiut 2023

Acknowledgment

All Praises and Thanks Be to Allah for the success and his help for us to finish the project this year.

During this year we had to take advice and support from a boom of respectable people and we had to thank them for their time and effort and we would like to express our gratitude and thanks to them and we would like to show this to our supervisors:

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For giving us a good guideline for the Project throughout numerous consultations. We would also like to expand our deepest gratitude to all those who have directly and indirectly guided us in doing this Project.

Many people, especially our classmates and team members itself, have made valuable comment suggestions on this proposal which gave us an inspiration to improve our project. We thank all the people for their help directly and indirectly to complete our project.

Abstract

Muscle injuries are common in sports. They are usually caused by either acute (mostly eccentric mechanisms) or chronic overloading with a lack of muscle coordination. They present in clinical practice as bruises and muscle sprains. Due to the rigours of a modern society and the high economic cost of time off work, an effective treatment needs to be employed. The key to an optimised therapy rests in the appropriate timing between immobilisation and mobilisation. The interval to muscle repair might be shortened by certain adjuvant therapies. In doing so, it is important that no physiological phases of wound healing are overlooked. Muscle healing can be accelerated by externally induced higher metabolic turnover. Surgical therapy is sometimes necessary in selected cases and in serious injuries.

Purpose of review

The aim of this review is to discuss the most common muscle injuries in sports, state-of-the-science classification, and return to play recommendations, focused on the role of imaging findings and new techniques.

Recent findings

New efforts for more accurate classification and grading system resulted in detailed and precise terminology, such as showed in the Munich consensus and later by the British Classification system. Advanced imaging, such as MR T2 mapping, MR spectroscopy, and DTI may give further information on injured muscles' functional status and fibers' recovery, but it still faces cost and availability issues, which reduce its application in the professional athletes setting.

Summary

Muscle injuries in sports usually result in time lost from training and competition. High-level athletes may miss several matches or competition per season, with significant economic impact for clubs and sponsors. Accurate muscle injury classification with clinical evaluation and imaging techniques is vital for proper treatment and season planning. MRI is the method of choice to evaluate the location, size, and characteristics of the injury and it is crucial for classification and treatment planning. Ultrasound imaging performed by experienced radiologists, especially inside training/recovery facilities of professional teams, is useful to diagnose acute injuries and in the follow-up of the athletes' recovery by seriated imaging.

Contents

Chapter 1: Introduction

1.1   Introduction:

Muscle injuries are the most frequent cause of physical disability in sports practice. It is estimated that between 30 and 50% of all sports-associated injuries are caused by soft tissue injuries.1 This incidence may be higher according to the sport. In athletics and soccer, ~ 30 to 41% of all injuries are muscular,2-4 while in weightlifting, muscle injuries account for up to 59%.5

Although nonsurgical treatment results in a good prognosis in most athletes with muscle injury, the consequences of treatment failure can be dramatic, postponing the return to physical activity for weeks or even months.6 Knowledge of some basic principles of skeletal muscle regeneration and repair mechanisms can help prevent imminent dangers and accelerate the return to sport.

How do muscle strains affect my body?
Muscle strains happen when you tear a muscle. They're painful. They might also cause other symptoms like bruising and weakness.

Your muscles are made of thousands of small fibers woven together. These fibers stretching and pressing together are what allow your body to move when you squeeze a muscle.

When you overuse a muscle, the strands of muscle fiber are stretched beyond their limit and tear apart. If you've ever tried to use an old bungee cord to hold something in place you've seen this happen.

New bungee cords — and healthy muscle fibers — have plenty of give and stretch. But if you use them for too long or suddenly jerk on them too hard, the elastic fibers in the bungee cord will start to pull apart. It's the same way in your muscles. Strains are what happens when some of the thousands of fibers in your muscles are pulled beyond their limit and tear.

You can strain muscles anywhere in your body. Some of the most common include:

- Hamstring.
- Calf.
- Chest.
- Back.
- Biceps.
- Abdominal (abs).

strain can occur as a result of improper body mechanics with any activity (e.g., contact sports, lifting heavy objects) that can induce mechanical trauma or injury. Generally, the muscle or tendon overstretches and is placed under more physical stress than it can withstand.[1] Strains commonly result in a partial or complete tear of a tendon or muscle, or they can be severe in the form of a complete tendon rupture. Strains most commonly occur in the foot, leg, or back.[3] Acute strains are more closely associated with recent mechanical trauma or injury. Chronic strains typically result from repetitive movement of the muscles and tendons over a long period of time.

Degrees of Injury (as classified by the American College of Sports Medicine):
First degree (mildest) – little tissue tearing; mild tenderness; pain with full range of motion.

Second degree – torn muscle or tendon tissues; painful, limited motion; possibly some swelling or depression at the spot of the injury.

Third degree (most severe) – limited or no movement; severe acute pain, though sometimes painless straight after the initial injury

To establish a uniform definition amongst healthcare providers, in 2012 a Consensus Statement on suggested new terminology and classification of muscle injuries was published.[5]

The classifications suggested were:

The major difference suggested was the use of "indirect" muscle injury verse "grade 1" to provide subclassifications when advanced images were negative.

Indirect Muscle Injury FUNCTIONAL (Negative MSK US & MRI)

Type 1: Overexertion-related Muscle Disorder
    Type 1a: Fatigue induced
    Type 1b: DOMS
Type 2: Neuromuscular muscle disorder
    Type 2a: Spine-Related
    Type 2b: Muscle-Related
STRUCTURAL MUSCLE INJURY (Positive MSK US & MRI)[6]
Type 3: Partial Muscle Tear
Type 4: (Sub) total tear

DIRECT MUSCLE INJURY
Bump or Cut: Contact-related.

1.2   Problem statement:
Many of us are exposed to sudden muscular injuries that may be difficult to bear, and at that time we cannot go to a doctor. Therefore, this program provides some important questions through which muscular injury can be diagnosed and its seriousness. It provides the patient with some practical and proven first aid steps that may help overcome the pain. At that time, and temporarily saving the situation... This does not negate the important role that the doctor plays in diagnosing the situation we

1.3   Motivation:
The main objective of this application is to diagnose muscle injury, determine its severity, and clarify whether the patient is obliged to go to the doctor, or is it just a mild injury and can be treated with some first aid provided through the application
 It also provides some instructions that describe the types of muscles and muscle injuries, dividing them into degrees according to the seriousness of the condition, and some tips for dealing with the injury before and after the diagnosis

1.4   Final Considerations:

Understanding the pathophysiological mechanisms that regulate muscle repair and its adaptation to physical training are essential for the professional who proposes to treat these patients. They are the basis for the development of means of injury prevention and for the proper treatment and rehabilitation of installed injuries.

Regarding the appropriate time of return to training specific to the sport, the decision can be based on two simple and inexpensive measures: the ability to lengthen the injured muscle as much as the healthy contralateral side, and absence of pain in the injured muscle in basic movements.

When the patient refers to reaching this point in recovery, permission to gradually start the exercises specific to the sport is guaranteed. However, it should always be emphasized that the final phase of rehabilitation should be carried out under the supervision of a qualified professional.

Chapter 2:
muscle injuries

2.1 Definition of muscle?

Muscles are what allow us to move and live. And every movement in thebody is controlled by muscles. Some muscles work without us thinking, like the heart muscle, but other muscles are controlled by our thoughts and allow us to do things and move.

There are more than 650 muscles in the human body. And they are under the skin covering our bones. And muscles often work together to help us move. And we don't have to think about moving each muscle individually.

2.1.1 What are the muscles?

Muscles are tissues that work to move the body and strengthen the skeletal structure. They consist of muscle cells that contract and relax in response to nerve signals. Muscles are found throughout the body, including the heart, intestines, and blood vessels, in addition to the skeletal muscles that move the body and maintain posture. Muscle types vary in shape and function, including smooth muscles found in the intestines and blood vessels, cardiac muscles found in the heart, and skeletal muscles that move the body and maintain posture.

2.1.2 muscle injury: -

Muscle injury refers to any damage or trauma that occurs to the muscles, which can be caused by intense physical exercise, overexertion of the muscles, sports injuries, accidents, or chronic illnesses. Symptoms of muscle injury include pain, swelling, numbness, weakness, cramping, and can impact movement and the ability to perform daily activities. Some muscle injuries may require rest and physical therapy, while others may require medical treatment such as medication or surgery.

2.1 Five injuries months?

A long and successful sports career may end with one injury, forcing a person to retire from sports permanently, to undertake a long journey of treatment, which may extend for years.
In the following report, "The Consulto" reviews the most common injuries among athletes.

2.1.3 Contusion: -

Skin bruise

A bruise begins a
pinkish red color

"Ecchymosis" is the medical term for bruises. These form when blood pools under your skin. They're caused by a blood vessel break. Bruises look like a
mark on your skin that's black and blue or red to purple. Bruises change color as they heal and most don't need treatment. Unexplained bruises could be a sign of an underlying medical condition.

2.2.1.1 The contuion (ecchymosis) is :

"Ecchymosis" (pronounced "eh-chuh-mow-sis") is the medical term for a bruise. A bruise, or contusion, is skin discoloration from damaged, leaking blood vessels underneath your skin. Even though there's blood pooling underneath your skin, you won't have any external bleeding unless your skin breaks open. The collection of blood makes a bruise visible. Bruises form a mark on your skin that ranges in color from black, blue, purple, brown or yellow. Your body's blood cells repair damaged blood vessels to help you heal.

2.2.1.2   people most prone to contusion:

Contusion are very common and will affect everyone at some point in their life. contusion can occur from a fall, accident, sports injury or medical procedure.
People older than 65 years are more likely to bruise, along with women and people assigned female at birth.

2.2.1.3   the symptoms of a contuion (ecchymosis):

Bruises range in size, shape and color depending on the type of bruise, cause and location. Symptoms of a bruise include:
Pain or tenderness (sore feeling) when you touch the bruise.
Skin discoloration (red to purple, black, brown or yellow).
Swelling or a raised bump on your skin (hematoma).

2.2.1.4   The color of contuion :

Bruises are sometimes called black-and-blue marks. They may appear red or purplish at first. If you have a darker skin tone, you may notice purple, dark brown or black bruising. As the area heals, the bruise may turn a lighter shade of brown, green or yellow.

2.2.1.5   The causes contuion (ecchymosis):

Broken blood vessels cause bruises to form on your skin. Blood vessels are tubes that carry blood throughout your body. Blood vessels can break or leak like a cracked pipe. This causes blood to seep out of your blood vessel and pool
underneath your skin, as there isn't an opening (wound) for your blood to get out of your body. The pooling of blood causes a visible sign of a bruise on your skin (skin discoloration). Your blood cells (platelets) are your body's plumbers to repair the leak in your blood vessels. Platelets stop bleeding within your body to heal your bruise.
There are several ways that your blood vessels could break, including:
 An injury or physical trauma to your body.   Aging skin.
 A symptom of taking a medication (like anticoagulants, antiplatelet medicine, aspirin or steroids).
Having a condition or receiving treatment that affects your blood platelet count (such as autoimmune diseases, leukemia or hemophilia).

2.2.1.6   contuion (ecchymosis) diagnosed:

You and your healthcare provider can identify a bruise by your symptoms, especially the look and color of the mark on your skin. Your provider can further identify what type of ecchymosis you have based on your symptoms.
If you experience frequent or unexplained bruising, your provider may order tests to rule out possible causes. These tests include:
 X-ray to check for bone fractures.
 Blood tests to check for clotting conditions and vitamin deficiencies.

2.2.1.7   contuion (ecchymosis) treated:

Most bruises fade away and don't need treatment. More severe bruises might need treatment. You can help your bruises heal faster by:
Resting and elevating the injured area to prevent swelling and to relieve pain.
Applying ice packs for the first 24 to 48 hours after injury. Wrap the ice pack in a towel and apply ice for no more than 15 minutes at a time.
Repeat throughout the day.
Applying a heating pad or warm compress to the injured area after two days. You can apply heat several times throughout the day.
Taking over-the-counter pain medication, such as acetaminophen. Check with your provider before using NSAIDs.

2.2.2 Muscle-strain:-

Muscle spasms are sudden, involuntary contractions that occur in various muscles, and are often very painful. They may affect different muscles in the body:

- the back of the leg
- The back of the thigh
- abdominal wall
- hands
- feet

In most cases, the muscle tension extends between seconds to a quarter of an hour, but it may extend for a longer period sometimes, and it may be accompanied by swelling of the muscle tissue under the skin.

2.2.2.1 The muscle strain is:

Muscle strain or a "pulled muscle" is a partial or complete tear of a muscle. These injuries typically occur:
 in muscles that cross two joints
 during explosive action, such as sprinting
 during times when athletes suddenly increasing their exercise regimens (such as during training camps)

2.2.2.2 Normal muscle anatomy and function:

A muscle is surrounded by an outer sheath that allows it to move smoothly over the surrounding tissues as it contracts. Inside the outer sheath are bundles of muscle fibers known as fascicles, which are further made up of myofibrils. These myofibrils are composed of millions of microscopic units called sarcomeres that are responsible for muscle contraction. In the sarcomere, muscle proteins called myosins pull against thin ropes of protein called actin when they are stimulated by nerves. When this occurs, the sarcomeres shorten, resulting in a contraction. When the myosin proteins relax, the sarcomeres lengthen back to their original position and so does the muscle.
The combination of muscle contraction and relaxation is coordinated through the nervous system. This is what allows athletes to run, kick, throw, and, for that matter, even walk and breathe.

2.2.2.3   The causes of muscle strains:

Muscle strains occur when the force on a muscle is so great that the tissue begins to tear. The tear can occur in one of three places:
within the muscle itself at the junction between the muscle and tendon (most common) in the tendon, where it attaches to the bone

Muscles, by way of their tendon attachments at each end, insert into bones and provide the force required for movement. During activities that require explosive movements, such as pushing off during a sprint or changing directions during racquetball, the force across the musculotendinous unit (the connected muscle and tendon) can be so great that tissues tear, either partially or completely.

These injuries commonly occur during excessive loading of the muscle; that is, when the muscle is contracting while it is elongating. Muscles that cross two joints, such as the hamstrings (the hip and knee joints), the calf (the knee and ankle joints), and the quadriceps (the hip and knee joints) are the most susceptible to injury. The hip adductor muscles are also commonly affected, though they only cross the hip joint.
Factors that can predispose an athlete to injury include older age, previous muscle injury, less flexibility, lack of strength in the muscle, and fatigue.
Many athletes sustain muscle injuries when they just begin a training regimen. That is why they are much more common in training camps in the NFL than they are throughout the regular playing season.

2.2.2.4 Are there different types of muscle strain:

The severity of a strain can be assessed by how much strength and range of motion a person loses, and this can also provide an idea as to how long it will take to recover.

2.2.2.5 Muscle strains can be categorized into three grades, based on severity:

- **Grade 1:** Mild damage to individual muscle fibers (less than 5% of fibers) that causes minimal loss of strength and motion.
- **Grade 2:** More extensive damage with more muscle fibers involved.
  However, the muscle is not completely ruptured. These injuries present with significant loss of strength and motion. These injuries may require two to three months before a complete return to athletics.
- **Grade 3:** Complete rupture of a muscle or tendon. These can present with a palpable defect in the muscle or tendon. However, swelling in the area may make this difficult to appreciate. These injuries sometimes require surgery to reattach the damaged muscle and tendon.

2.2.2.6   the signs and symptoms of muscle strain:

The key symptoms of a muscle strain are: sudden pain that worsens while contracting the muscle, swelling and bruising, loss of strength and range of motion. People often report the sensation of pain as the feeling of being "stabbed." When muscle is initially injured, significant inflammation and swelling occurs.

After this inflammatory phase, the muscle begins to heal by regenerating muscle fibers from stem cells that live around the area of injury. However, a significant amount of scar tissue also forms where the muscle was injured.

Over time, this scar tissue remodels, but the muscle tissue never fully regenerates. It is thought that this makes a strained muscle prone to future injury.

2.2.2.7   The muscle strain diagnosed:

The diagnosis is usually made based on patient history and physical exam. In severe, grade 3 cases, the examining physician may actually be able to feel the defect where the muscle has completely torn.

An X-ray may be helpful to rule out a fracture or dislocation as the cause of pain. Occasionally in young athletes, the tendon can pull off a piece of bone where it attaches, which can be seen on X-rays.

However, pure muscle injuries cannot be seen on regular X-rays. An MRI can sometimes be helpful to determine where the injury has occurred and whether there is complete rupture or not. MRIs can also show collections of blood, called a hematoma, that sometimes occur following severe injuries.

2.2.3 Muscle strees:

Process of stiffness and pain development
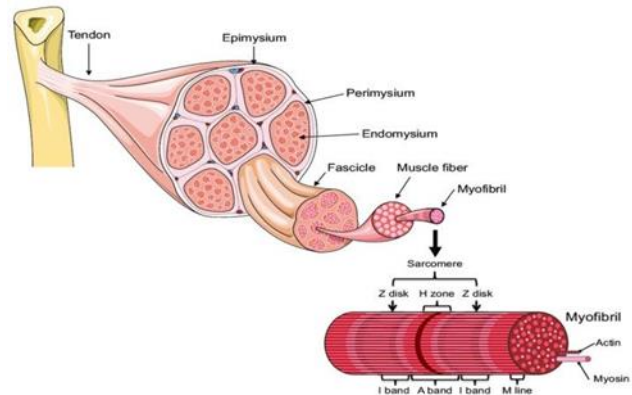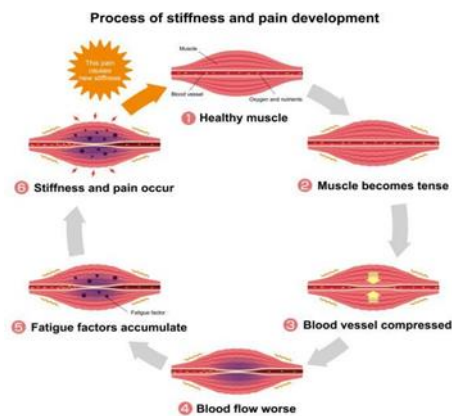
Repeated, intense use of muscles leads to a decline in performance known as muscle fatigue. Many muscle properties change during fatigue including the action potential, extracellular and intracellular ions, and many intracellular metabolites. A range of mechanisms have been identified that contribute to the decline of performance. The traditional explanation, accumulation of intracellular lactate and hydrogen ions causing impaired function of the contractile proteins, is probably of limited importance in mammals.

Alternative explanations that will be considered are the effects of ionic changes on the action potential, failure of SR Ca2+ release by various mechanisms, and the effects of reactive oxygen species. Many different activities lead to fatigue, and an important challenge is to identify the various mechanisms that contribute under different circumstances. Most of the mechanistic studies of fatigue are on isolated animal tissues, and another major challenge is to use the knowledge generated in these studies to identify the mechanisms of fatigue in intact animals and particularly in human diseases.

2.2.3.1　UNDERLYING CAUSES AND SITES OF MUSCLE STREES:

Muscle strees can be broken down essentially into two main components: central (neural) and peripheral (muscular). Peripheral fatigue refers to the motor units and involves processes associated with mechanical and cellular changes in the muscular system.11 Central fatigue refers to the physiological processes that occur within the central nervous system (CNS). Although many researchers would agree that both peripheral and central factors play a role in muscle fatigue, the relative contribution of both may vary and remains poorly understood. Following is a brief discussion of the various aspects of neuromuscular fatigue and the mechanisms involved.

2.2.3.2　Muscle strees and loss of endurance:

Physiologic muscle strees has been defined as an inability to sustain a predictable maximal force during voluntary contraction, and is commonly associated with LMN dysfunction .Muscle fatigue and decreased endurance are frequent and disabling symptoms for MND patients, and contribute to decreased walking speed and increased stride time .However, stride time and stride-to-stride variability abnormalities have also been demonstrated to occur during the first 60 strides of walking ,when the degree of muscle fatigue from LMN contributions would be at its lowest. Thus, the amount of influence of this symptom on gait disturbance remains unclear, and contributions from overlying UMN dysfunction may also influence these gait changes .

2.2.3.3 Effects of strees on lower extremity proprioception:

Muscle strees reduces the force-generating capacity of the neuromuscular system, which essentially leads to increased laxity in the knee joint.84 Skinner et al28 found an increase in laxity of the ACL measured with a KT1000* arthrometer after a fatigue protocol. Similarly, Weisman et al85 found increased laxity in the medial collateral ligament in athletes at a university after participation in various sporting activities. Furthermore, studies in the literature2,28,86,87 have shown a decrease in the sensitivity of muscle receptors under fatigue conditions. The consequences of decreased proprioceptive sense from fatigue can be deleterious because of the possibility of sustaining injuries under these conditions when higher-level activities are performed. Skinner et al28 studied the effects of fatigue on joint position sense and knee angle reproduction in a group of healthy, highly trained male recruits in the Special Forces division of the Navy. Subjects underwent an interval running program followed by isokinetic measurement of knee extension and flexion. Fatigue was determined by the percent decrement in work output measured from pretraining to posttraining conditions on an isokinetic device. The authors concluded that after fatigue ensues, values on angular replication tests are significantly decreased, but no significant changes were noted in the threshold of movement sense. They determined that loss of muscle receptor efficiency as a result of fatigue played a key role in angular replication errors. The authors concluded that the dual role of afferent input by the receptors in the contractile and noncontractile elements of the knee is important for proprioceptive sense.

Lattanzio et al25 conducted a study involving healthy male and

female subjects performing three different cycling protocols (ramp, continuous, and interval training) at a percentage of theiro2max. In this study, methods for determining the threshold for detection of movement were similar, but angular replications were performed with subjects in the standing weight-bearing position instead of the seated open kinetic chain (OKC) protocol used in the study of Skinner et al. The results of the study of Lattanzio et al25 were similar to those of Skinner et al, with statistically significant decrements in joint replication in male subjects after the three different fatigue protocols. Female subjects similarly showed significant differences in joint replication after the continuous and interval programs, but not with the ramp protocol for joint angular replication. The conclusions drawn by the authors of this study were that anatomic gender differences possibly account for the variation in proprioception in response to fatigue.

Finally, Barrack et al30 and Barrett et al73 studied the effects of total knee replacement on knee joint proprioception. This research paradigm is of particular interest because insertion of a total knee joint prosthesis results in removal of most joint receptors in the human knee. Both groups of investigators found no significant loss of proprioception in the extremity that underwent total knee replacement in comparison to the contralateral extremity 6 months postoperatively. These groups of authors both concluded that their research again points to the important role that muscle-based mechanoreceptors play in knee joint proprioception.

2.2.3.4   Peripheral strees and Muscle strees:

Muscle strees is considered a natural consequence of physical training; however, its causes may differ depending on the intensity and duration of exercise. Low intensity long-lasting training decrease the glycogen content of the musculature. The muscular system, unlike the nervous system, is able to store huge amount of energy in the form of glycogen, which may decrease by 25%–30% during a 15 km flat race, as measured by muscle biopsy. After several hours of competition like a marathon or triathlon, decreased glycogen level may cause underperformance. Glycogen stored in muscle shows sporadic distribution in muscle fibers and also the differential activation rate of muscle fibers causes a diverse decrease, thus a 20%–30% decrease is manifest in different absolute levels in each muscle fibers. Decreased glycogen can be considerable during serial loading (e.g., European Championships, World Championships, Olympic Games). Thus, carbohydrate supply before competition can prevent fatigue-related underperformance.

Skeletal muscle contains a high amount of nitrogen oxide synthase (NOS), which produces a relaxant, nitrogen oxide (NO). NO is also generated in smooth muscle cells (discussed in detail in the section on the cardiovascular system). Nitrogen oxide inhibits the attachment of actin-myosin filaments, and it has a role in the development of fatigue as well as after low intensity, long-lasting training in particular. Muscle contractions are the results of a series of ion (Na+, K+, Ca++, H+) translocations during long-lasting training. The efflux of K+ increases its concentration in the extracellular space, resulting in impaired muscle contraction. Calcium ions have long been associated with fatigue. Ca++ binding to

tropomyosin results in uncovered myosin binding sites of actin. A lack of calcium ions prevents the development of cross bridges between actin and myosin fibers, leading to impaired contraction. This type of fatigue has been observed during low intensity, long-lasting training.

According to recent research, Ca^{++} from the endoplasmic reticulum stimulates mitochondrial ATP production in addition to its central role in muscle contraction. Over a certain level it increases the level of free radicals, which promotes the development of fatigue. Free radicals in low quantities stimulate contraction, whereas high amounts of oxidants inhibit it. The underlying mechanism behind stimulation involves their actions on signal transduction and results in the stimulated efflux of calcium ions from the sarcoplasmic reticulum, and increased sensitivity of calcium ion channels, which facilitates muscle contraction. High levels of oxidants, however, decrease calcium ion efflux from the sarcoplasmic reticulum, and also induce structural changes in proteins, resulting in impaired biochemical function and impaired muscle contraction.

Thus, antioxidant supply either stimulates or attenuates the rate of muscle contraction.

As glycogen level decreases and promotes underperformance during long- lasting training, the decrease of CP (creatine phosphate) also promotes fatigue during high intensity training. Accumulation of creatine phosphate is limited; this mechanism will be discussed in the chapter about diet.

High intensity training promotes the increase of $H+$, and lactic acid, which results in underperformance, while alkalosis aids in recovery. A low pH deteriorates the connection of actin-myosin muscle fibers. Actin-myosin binding and cross bridges formation involve a weak attachment state and a power stroke

stage. A low pH increases the percentile of low attachment cross bridges, while that of power strokes decreases. In addition, a low pH during anaerobic conditions damages troponin structure, which directly impairs muscle contraction.

Impaired contraction can also be caused by increased levels of Pi and ADP; in addition, its role in fatigue has been explored in intensive muscle contractions. Pi and ADP compete with ATP for the ATP binding sites on myosin, and a high concentration of Pi or ADP deteriorates ATP binding and weakens muscle contraction. ADP-ATP translocation needs to be fast, which demands ATP, thus
the level of Pi or ADP as side products of muscle contraction exceeds ATP in fast movements.

Calcium ion binding to tropomyosin is inevitable in muscle contraction. Impaired calcium ion reuptake by the sarcoplasmic reticulum prevents muscle relaxation, and the lack of relaxation of the antagonist muscle may result in a pulled or ruptured muscle. This can be seen in thigh flexors in sprinters during racing. Fatigue caused by impaired calcium ion reuptake occurs primarily during high intensity exercise; this can be attenuated by caffeine consumption, since caffeine promotes calcium ion uptake by sarcoplasmic reticulum.

2.2.3.5 In summary

the development of fatigue is influenced by the characteristics of physical training such as intensity, duration of the training, and also environmental factors (external temperature and humidity, audience, etc.). We need to emphasize that the adaptation profile and the time needed for regeneration

2.2.4 MUSCLE TEAR:
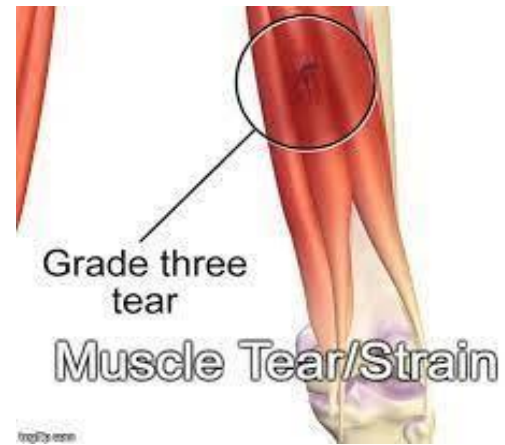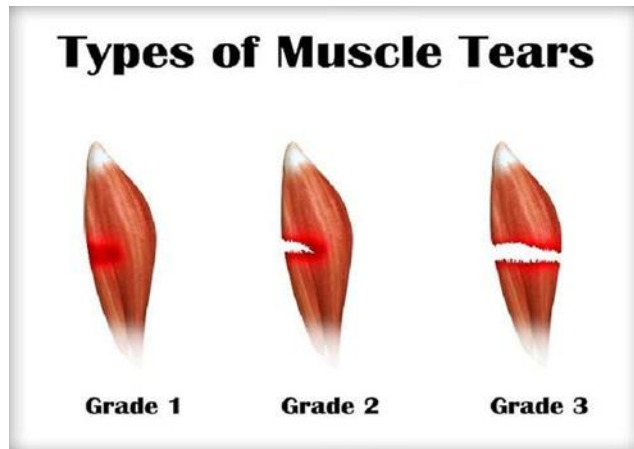
A muscle tear, also known as a muscle strain or pull, refers to soft tissue damage that has been done to a muscle or its tendons. Injuries to the muscle and tendons can also involve some of the surrounding structures including nerves. These injuries can range from mild to severe, and can alter function if not treated properly.

2.2.4.1 The Tears in Muscles Happen:

Muscle tears can happen when a muscle is overstretched to the point that the muscle is damaged. This can occur when a person is doing daily activities or heavy lifting as well as from sports activities. These tears can be partial or complete, depending on the severity of the injury. When a complete muscle tear occurs the entire muscle is torn or detached from the tendon. Injuries to the muscle-tendon unit can cause immense pain due to their extensive blood and nerve supply.

2.2.4.2   The Tears of Diagnosed:

There are three levels of tears or strains, each increasing in intensity. In a Grade 1 strain, the muscle fibers are stretched beyond their usual length. Stress or pain may not be felt in a Grade1 strain until the activity that caused the injury is completed. While there may be some tightness during the activity, pain is not felt until the activity is over and the muscle is relaxed. A Grade 2 strain occurs more quickly and may even be immediate. This injury occurs when some of the muscle fibers are torn and some are stretched beyond their normal length.

There is pain when the muscle is stretched and it is sensitive to touch but no gap can be felt. A Grade 3 is the most severe and often results in a complete tear of the fibers. Some patients report a feeling of the muscle tearing apart. There may be a lump or bruising where the tear has occurred. Often a palpable gap in the muscle can be felt.

2.2.4.3   the Treatment Options for Muscle Tears:

Depending on the severity of the injury, there are several treatment options available for those suffering from a muscle tear.

- **Grade 1 Tear**
  At Pontchartrain Orthopedics and Sports Medicine, we usually recommend treating minor Grade 1 muscle tears with rest and ice in conjunction with over-the-counter pain relievers and anti-inflammatories. Patients with muscle tears will also be instructed to perform rehabilitation

including stretching the muscle to promote proper healing.

- **Grade 2 Tear**
  In addition to the rest and ice in conjunction with over-the-counter pain relievers associated with a Grade 1 injury, Grade 2 muscle tears may require physical therapy to properly recover.

- **Grade 3 Tear**
  Severe Grade 3 muscle tears may require surgical intervention to heal properly. Some other specialized treatments for moderate to severe muscle tears include Ultrasound Guided Injections. These injections are sometimes used to treat muscle tears because they effectively target a precise area and are able to reduce inflammation, which enables a tear to heal more effectively. Regenerative therapies may also be used to treat muscle tears
  because they stimulate the patient's body to create new, living, functional tissues to treat injuries which may otherwise heal slowly, or not at all.

Patients who believe they have torn a muscle should schedule an appointment to determine the severity of their injury. Only then can an appropriate treatment plan be determined.

2.2.4 Muscle inflammation:
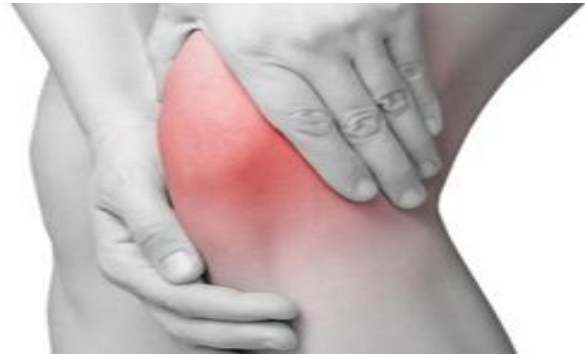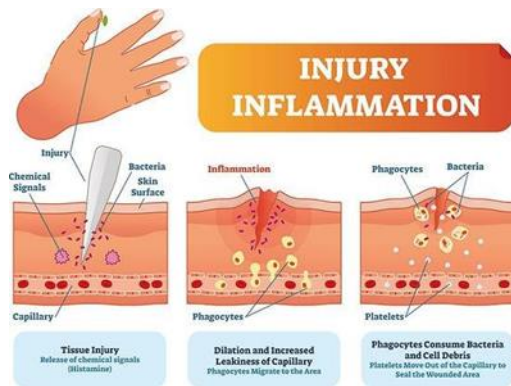
Inflammatory muscle diseases (often referred to as "inflammatory myopathies" or "myositis") are a group of muscle diseases characterized by chronic muscle inflammation, inflammation of tissues associated with the muscles, muscle weakness, and occasionally muscle pain (depending on the specific case).

2.2.4.1 The (inflammation) myopathies:

"Myopathy" is a medical umbrella term that describes muscle diseases, including inflammatory myopathies (or inflammatory muscle diseases). The word "myopathy" quite literally means 'muscle inflammation'. ("Myo" means 'muscle' and "itis" means 'inflammation'.)
There are four main types of chronic inflammatory myopathies:

• Polymyositis:
Polymyositis is an inflammatory myopathy that affects the skeletal muscles responsible for movement. When this disease is present, the inflammatory cells are misfiring and directly targeting the muscle fibers. Polymyositis is found in women more often than men.
• Dermatomyositis:
Dermatomyositis is another inflammatory myopathy that attacks the blood vessels responsible for transferring blood to the muscles and the skin. This disorder causes skin rashes and progressive muscle weakness and is most commonly found in women and children.
• Inclusion Body Myositis:
Inclusion body myositis is an inflammatory disease, but also a degenerative muscle disease. When inclusion body myositis is present, a person experiences muscle weakness and muscle shrinkage as the muscles degenerate (or deteriorate). This disease is most commonly found in people over the age of 50.

• Necrotizing Autoimmune (inflammation) Myopathy:
Necrotizing autoimmune myopathy (an inflammatory myopathy) causes weakness around areas in the upper and lower

body. People who have this disorder often experience dizziness, fatigue and muscle pain when climbing stairs or standing up quickly.

• General Symptoms of (inflammation) Myopathies:

The four chronic inflammatory myopathies can affect both adults and children. The general symptoms of these diseases include:

Progressive muscle weakness that begins in the proximal muscles (the large muscles that hold significant body mass, like the neck, shoulders, and hips)

Muscle fatigue after walking, standing, tripping or falling

Difficulty swallowing or breathing

Increased risk of cancer, specifically in polymyositis and dermatomyositis disorders

Myopathies are rare and typically aren't life-threatening. There are also effective treatment methods available to help improve muscle functionality and mitigate unpleasant symptoms of most myopathies.

2.2.4.2 The causes of (inflammation) myopathies:

Autoimmune disorders are caused by the body's immune system attacking other healthy cells within the body. With inflammatory muscle disease
specifically, the immune system is attacking the body's healthy muscle fibers, blood vessels, connective tissues, organs, and joints.
The immune system misfires, mistaking healthy cells for foreign invaders (like bacteria and infections). The cause behind these autoimmune misfirings in inflammatory myopathies is unknown. Some of the most common autoimmune diseases are type 1 diabetes, rheumatoid arthritis (RA), psoriatic arthritis, multiple sclerosis, systemic lupus erythematosus (SLE), Inflammatory bowel disease, and celiac to name a few.
Although, the cause behind the inflammatory response is known. Inflammation occurs as a response to autoimmune cell damage; inflammation of the muscles destroys muscle tissue, and over time, can cause complete loss of muscle— called muscle atrophy.
Inflammation can occur both internally and externally. Inflammation of the muscles isn't necessarily a sprained ankle or a red, inflamed area on the body (like we see with external inflammation). Inflammatory muscle diseases cause the destruction of the internal organs and tissues. In both cases (internal and external inflammation), inflammatory cells rush to the site of the affected area.
The cells then release various chemicals, including histamine, bradykinin, and prostaglandins, which cause the blood vessels to release fluid into the tissues, resulting in swelling and inflammation.

2.2.4.3   the symptoms of each (inflammation) myopathy:

There are some universal symptoms that myopathies share, such as general muscle weakness, but each type of myopathy is also characterized by its own unique symptoms.

2.2.4.4   Polymyositis:

Over a period of several weeks to a few months, the muscles will gradually weaken. The hips, thighs, upper arms, and top part of the back (the muscles that move and support the neck) are most affected by this muscle weakness. Nearly all of the muscles required to hold the body in an upright position become progressively weaker, which makes it very difficult to perform daily tasks and regular activities.
Because the muscles in the neck are affected, it can be difficult to eat and swallow, which can result in weight loss and malnutrition.

It can be difficult to fully extend the knee too, which makes it challenging to lift objects, climb stairs, and walk on inclines. Polymyositis can also affect the heart muscle, which can cause a condition called inflammatory cardiomyopathy, or myocarditis. Respiratory problems and difficulty breathing often occur with polymyositis, as the muscles required to breathe are affected.

2.2.4.5   Dermatomyositis:

Dermatomyositis is also sometimes known as 'polymyositis with a rash', due to the similarities between these two disorders. The "derma", or skin aspect of dermatomyositis, differentiates it from other muscular diseases.

Dermatomyositis causes reddish, purple rashes on the face, neck, chest, upper back, elbows, knees, and shoulders. These patches of skin are often dry, rough or scaly, and commonly resemble sunburns.

Calcinosis (small deposits of calcium build up under the skin) can develop, which causes pain and discomfort. This symptom has been more prevalent in children and young people with dermatomyositis.

Panniculitis (inflammation of fat that causes small bumps under the skin) can also occur. This often affects the muscles in the hips, upper arms, shoulders, upper legs and neck.

Dermatomyositis can affect the breathing muscles (similar to polymyositis), causing respiratory complications.

Inflammation of the heart tissue can also occur, causing cardiac complications.

2.2.4.6   Inclusion Body Myositis:

Inclusion body myositis often begins with a gradual progression of muscle weakness in the hands (specifically the wrists and fingers), along with the quads in the front of the thighs, and the muscles in the foot. This muscle weakness

ranges from mild to severe and often makes it difficult to grip or hold things that require bending the wrists and fingers.
Poor balance is a common symptom, as people with inclusion body myositis can struggle to hold themselves up due to muscle weakness.
Difficulty swallowing and eating can occur because this disease frequently affects the throat muscles involved in swallowing.
Necrotizing Autoimmune Myopathy

Similar to polymyositis and dermatomyositis, necrotizing autoimmune myopathy causes muscle weakness in the upper and lower body. This can cause difficulty sitting in an upright position, climbing stairs, and carrying heavy objects.

Symptoms often arise much quicker and with far greater severity than other types of myopathies. Unlike other myopathies, the symptoms of necrotizing autoimmune myopathy can reach peak severity in only a matter of days.
This disease can develop following a viral infection, or appear with no specific cause.
"Several risk factors including statin use (34%), malignancy (9.5%), and connective tissue diseases (4.2%) have been identified, whereas more than 50% were idiopathic in nature."

Chapter 3:
Get the data

3.1 : Explanation of the data

Data is the main part in building this project, and on this basis the project is built and completed, and without it it was not completed. Therefore, the team struggled a lot to obtain data from more than one source, and it was not satisfied with one source,

and that is to understand the data and muscles in a clearer way to know how to deal with muscle injuries, so we have interviewed many And a lot of specialized doctors, as well as doctors from the

College of Physiotherapy and other practical colleges specialized

in one way or another in the muscles, and this is also due to the importance of dealing with the risks of these injuries, because it is almost a specific injury in the muscles that leads to a bigger problem in the human body, so it is necessary to take care of ourselves well.

3.2 we visited some universities

Muscle Injury Colleges Visited
Tim for teams and descent were divided into some targeted colleges for the use of application muscle injuries as an example (physiotherapy faculty University of Spink, Faculty of Mathematical Education University of Assiut, University of Draya of Minya... etc.)

3.3 University of Sphinx:

He was interviewed with doctors and restorers of
the University of Wedges and showed us
the difference between dealing with surface muscles and
extremities such as arm and leg and dealing with almost
hazardous internal muscles such as spine and stomach muscles,
etc. Also, how to deal with his own injury to
limb muscles in terms of initial diagnosis of the injury was
explained by some questions provided by the Application.

3.4 Faculty of Mathematical Education, University of Assuit
Some Sports Education Faculty
doctors were interviewed, including Prof.Dr. Mead Shaban Ali,
Dean of the Department of
Training, as well as some other professors

3.5 Expert Dr. Mahmoud Al-Ghazali:

Meting Zoom was held with Expert Dr. Mahmoud
Al-Ghazali. Dr. explained briefly to us about
different muscle injuries.
He confirmed that only surface muscles
should be treated such as muscle bruising or
tightening and that for patient safety.
He also provided us with statistics that were
already done on some of the injured and how some injuries were
diagnosed through simple questions.

3.6 Convert symptoms to Variable

Variables	Facts
A	Pain when using the affected muscle
B	The presence of bleeding
D	Feeling tingling
E	Gradually increasing swelling during the first 24 hours of the injury
F	Change the color of the skin
G	Presence of a tumor
H	The presence of a clear blood gathering around the injury site after 48 hours
I	The temperature changes objectively
J	The injured muscle can be moved with a simple movement
K	The injury occurs due to trauma or external violence such as colliding with a solid object
L	Feeling pain in the form of tingling or numbness
M	There is a slight continuous contraction in the affected muscle
N	The continuous contraction can be seen and touched by hand
O	The injured muscle cannot be moved
P	It occurs as a result of an involuntary contraction of the muscle so that it cannot be relaxed
Q	The patient feels stiff when stressed

R	The patient's feeling of muscle weakness and lack of flexibility
S	Exacerbation of symptoms when exposed to cold
U	The patient feels pain when pressing on the affected area
V	The presence of a tumor to some extent
X	It occurs as a result of chronic stress and tension on the small fibers that connect the muscle to the bone
Y	Fatigue, extreme exhaustion, and decreased physical ability
Z	Low level of muscle coordination - muscle balance
K	Relatively lost muscle strength during use
B	The patient feels pain in the form of a knife strike
D	Blood pooling around the injury site
E	A small hole at the site of the injury
F	Violent muscle contraction
G	A decrease in the efficiency and capacity of the muscle, a gradual decline, with a feeling of severe pain when performing the muscular effort, which increases with continuity.
H	As a result of too much stretching of some muscle fibers
I	As a result of sudden violent muscle contraction to resist an external force at the moment of its occurrence when the muscle is not ready for that
J	Inability to use the injured muscle and complete the movement

- **injuries**

q	muscle contusion
S	**Partial rupture**
u	muscle strain
w	**Stress**
X	**Inflammation**
y	**Contraction**

3.7   : Dealing with questions

A number of questions have been identified for each of the targeted muscle injuries based on what has been explained through Expert Dr. Mahmoud Al-Ghazali and through these questions that the injured person responds to, the injury is identified and these symptoms are converted to facts (Varibel) so that they can be easily dealt with in the code and identified.

3.8 : Rule Building to Reach Result

After dealing with Varibel and facts and writing each show has a letter that has been built rules that lead to the conclusion of the injury. These rolls are built on the basis of the association of each show with the latter.
For example, there is a pain with bleeding leading to the tumor of the place of the injury. So in the rest of the rolls and the rest of the injuries and based on these rolls, we conclude the injury through the symptoms provided by the patient.
So the data was collected and dealt with

Chapter 4:
Expert System

1.1 expert system is:

An expert system is an artificial intelligence (AI) program that uses rules and knowledge to simulate the decision-making ability of a human expert in a particular domain. It is an AI-based computer program that imitates the decision-making ability of a human expert in a specific field, by combining human knowledge, expertise, and problem-solving tactics with computer technology , Expert systems are developed to solve complex problems and decision-making processes related to a particular area of expertise, such as medicine, engineering, finance, or law. Expert systems use knowledge-based reasoning to arrive at solutions, and their decision-making process is transparent and traceable. This makes them valuable tools for organizations that rely on accurate and timely decisions, especially in situations where human experts are not available or the timeframe is restricted

1.2   Components of expert system:

are computer programs that are designed to simulate the decision-making ability of a human expert in a specific domain. They typically consist of several components, including:

1. **Knowledge Base:** This is the part of the expert system that stores all the knowledge and information about the domain that the system is designed to work in. The knowledge base is typically built using a set of rules, facts, and heuristics that are obtained from human experts or other sources of domain knowledge.

2. **Inference Engine:** This is the component of the expert system that applies logical reasoning to the knowledge base in order to arrive at a solution or recommendation. The inference engine uses a set of algorithms and rules to reason about the available information and draw conclusions based on that information.

3. **User Interface:** This is the part of the expert system that allows users to interact with the system and provide input. The user interface can take many forms, such as a command-line interface, a graphical user interface, or a natural language interface.

1.3 inference engine:

is a component of an artificial intelligence system that is responsible for making logical deductions based on a set of rules and facts. It takes as input a set of rules and a set of known facts, and applies logical reasoning to deduce new facts or conclusions that can be inferred from the existing set of facts and rules.

Inference engines are commonly used in expert systems, which are computer programs designed to simulate human expertise in a particular domain. In an expert system, the inference engine is used to apply a set of rules to a specific problem or question, and to arrive at a solution or recommendation.

There are several types of inference engines, including forward chaining, backward chaining, and hybrid methods that combine both approaches. Forward chaining starts with known facts and uses rules to deduce new facts, while backward chaining starts with a goal and works backwards to find the rules and facts that support that goal. Hybrid methods combine elements of both forward and backward chaining to provide a more efficient and flexible approach to logical reasoning.

1.4 Components of inference engine:
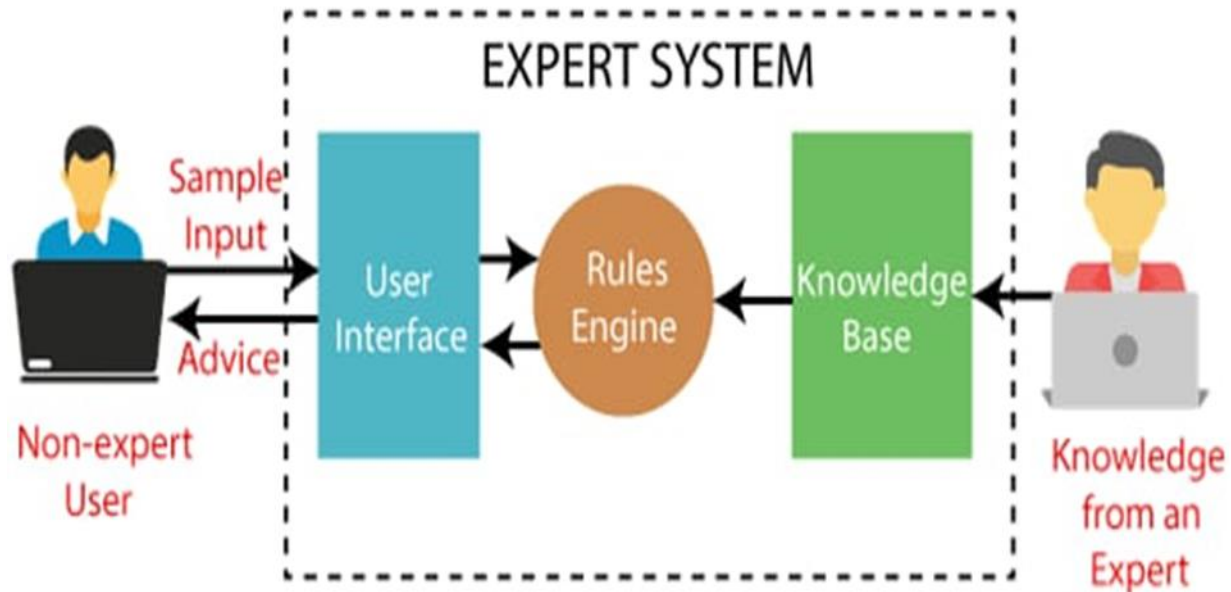
Forward chaining and backward chaining are two approaches used in artificial intelligence to reach a logical conclusion or solution. Both approaches follow different paths to reach the same goal.

Forward chaining is a bottom-up approach where the system starts with known facts and rules and uses them to generate new conclusions. It involves building a knowledge base and using it to make logical inferences and draw conclusions. This process continues until the system reaches the desired outcome.

On the other hand, Backward chaining is a top-down approach where the system starts with a goal or target and works backward to find the solution. It involves starting with a hypothetical solution and moving backward through the steps required to achieve that solution, checking for validity at each step. Backward chaining uses the rules and facts that lead up to a certain goal and helps determine the steps needed to reach that goal.

1.5 summary:

Forward chaining starts from initial data and reasons forward to reach a conclusion that satisfies the goal, while backward chaining starts from the goal and works back to find the causes that lead to the goal. Both approaches have their advantages and disadvantages and are useful in different scenarios, but they ultimately serve the same purpose of reaching a logical conclusion.
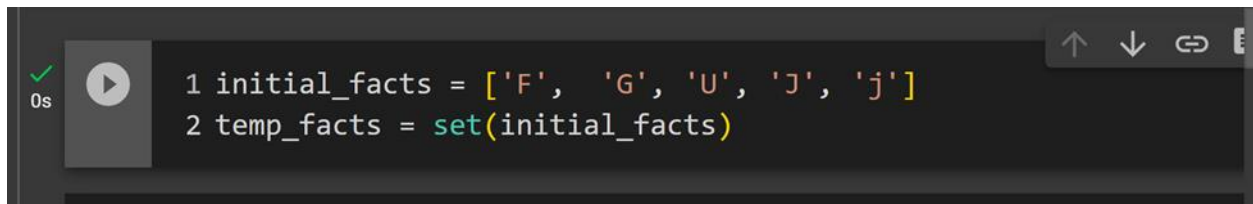
Chapter 5:
Implementation &Layout

5.1   FORWARD CHAINING CODE:

This code is an implementation of a forward chaining inference engine, which uses a set of rules and initial facts to derive new facts until no more new facts can be derived.

5.1.1   Defining Initial and Temporary Facts

```python
1 initial_facts = ['F', 'G', 'U', 'J', 'j']
2 temp_facts = set(initial_facts)
```

In this part, the initial facts obtained at the beginning are defined and saved in a list called "initial_facts". A temporary variable called "temp_facts" is created to store the temporary facts in each stage of the diagnosis determination process. The initial facts obtained at the beginning are assigned to this temporary variable.

5.1.2 Defining the Rules

```
1 rules = [
2      {'code': 'R1', 'conditions': ['B', 'K'], 'conclusion': 'q'},
3      {'code': 'R2', 'conditions': ['A', 'F'], 'conclusion': 'B'},
4      {'code': 'R3', 'conditions': ['F', 'G'], 'conclusion': 'H'},
5      {'code': 'R4', 'conditions': ['H'], 'conclusion': 'B'},
6      {'code': 'R5', 'conditions': ['G', 'I'], 'conclusion': 'H'},
7      {'code': 'R6', 'conditions': ['K', 'J'], 'conclusion': 'A'},
8      {'code': 'R7','conditions': ['j'], 'conclusion': 'b'},
9      {'code': 'R8', 'conditions': ['b', 'F'], 'conclusion': 'B'},
10     {'code': 'R9', 'conditions': ['i', 'B'], 'conclusion': 's'},
11     {'code': 'R10', 'conditions': ['h', 'B'], 'conclusion': 's'},
12     {'code': 'R11', 'conditions': ['U', 'G'], 'conclusion': 'R'},
13     {'code': 'R12','conditions': ['R'], 'conclusion': 'Q'},
```

```
10     {'code': 'R9', 'conditions': ['i', 'B'], 'conclus...
11     {'code': 'R10', 'conditions': ['h', 'B'], 'conclusion': 's'},
12     {'code': 'R11', 'conditions': ['U', 'G'], 'conclusion': 'R'},
13     {'code': 'R12','conditions': ['R'], 'conclusion': 'Q'},
14     {'code': 'R13', 'conditions': ['X', 'Q'], 'conclusion': 'x'},
15     {'code': 'R14', 'conditions': ['J', 'R'], 'conclusion': 'x'},
16     {'code': 'R15', 'conditions': ['O', 'A'], 'conclusion': 'Q'},
17     {'code': 'R16', 'conditions': ['Y', 'R'], 'conclusion': 'Z'},
18     {'code': 'R17', 'conditions': ['g', 'Q'], 'conclusion': 'w'},
19     {'code': 'R18', 'conditions': ['O', 'Z'], 'conclusion': 'Q'},
20     {'code': 'R19','conditions': ['J','A'], 'conclusion': 'k'},
21     {'code': 'R20', 'conditions': ['k', 'G'], 'conclusion': 'B'},
22     {'code': 'R21','conditions': ['h','F','G','k','B','F'], 'conclus...
23 ]
```

In this part, the rules that will be used to determine the diagnosis are defined. The rules in this code consist of data that specifies certain conditions and conclusions. Once the conditions are met, the specified conclusion is inferred. The initial facts are defined in a list containing the facts obtained from the patient at the beginning.

5.1.3　　Executing the Rules and Determining the Diagnosis

```python
1 executed_rules = set()
2
3 while True:
4     new_facts = set()
5     for rule in rules:
6         if all(condition in temp_facts for condition in rule['conditions']):
7             new_facts.add(rule['conclusion'])
8             executed_rules.add(rule['code'])
9     if not new_facts.difference(temp_facts):
10         break
11     temp_facts.update(new_facts)
12
13 print("Executed rules:")
14 print(executed_rules)
15
16 print("All available facts:")
17 print(temp_facts)
```

In this part, the diagnosis is determined based on the available facts and the rules that have been executed. The rules are executed and the temporary variable (temp_facts) is updated with the new facts inferred from executing the rules. This process is repeated until no new facts are determined. The rules that have been executed are saved in a variable called "executed_rules". In the end, the available facts and the rules that have been executed are printed.

5.1.1 Determining the Diagnosis

```python
1  diagnoses = []
2  if 's' in temp_facts and ({'R3', 'R4', 'R7','R8', 'R9', 'R10'}).intersection(executed_rules):
3      diagnoses.append('s')
4
5
6  if 'x' in temp_facts and ({'R11', 'R13', 'R12'} or {'R11', 'R12', 'R14'}).intersection(executed_rule
7      diagnoses.append('x')
8
9  if 'u' in temp_facts and ({'R19', 'R20', 'R21'}).intersection(executed_rules):
10     diagnoses.append('u')
11
12 if 'w' in temp_facts and ({'R15', 'R16', 'R17', 'R18'}).intersection(executed_rules):
13     diagnoses.append('w')
14
15 if 'q' in temp_facts and ({'R1', 'R2', 'R3', 'R4', 'R5', 'R6'}).intersection(executed_rules):
16     diagnoses.append('q')
17 if diagnoses:
18     print(f"\nThe diagnoses are: {', '.join(diagnoses)}")
19 else:
20     print("\nUnable to make a diagnosis.")
```

In this part, the diagnoses are determined based on the available facts and the executed rules. The code checks for the presence of each possible diagnosis based on the rules that have been executed and the available facts. If a diagnosis is possible based on the executed rules and available facts, it is added to the list of diagnoses. Finally, the list of diagnoses is printed. If no diagnosis is possible, a message indicating that no diagnosis could be made is printed.

5.1.5 The Run of the cod

```
Executed rules:
[4]

The diagnoses are: x
```

Finally, the new facts that have been inferred from each compatible rule and stored in `new_facts` are printed, by iterating through `new_facts` and using an f-string to display the rule code and the new fact.
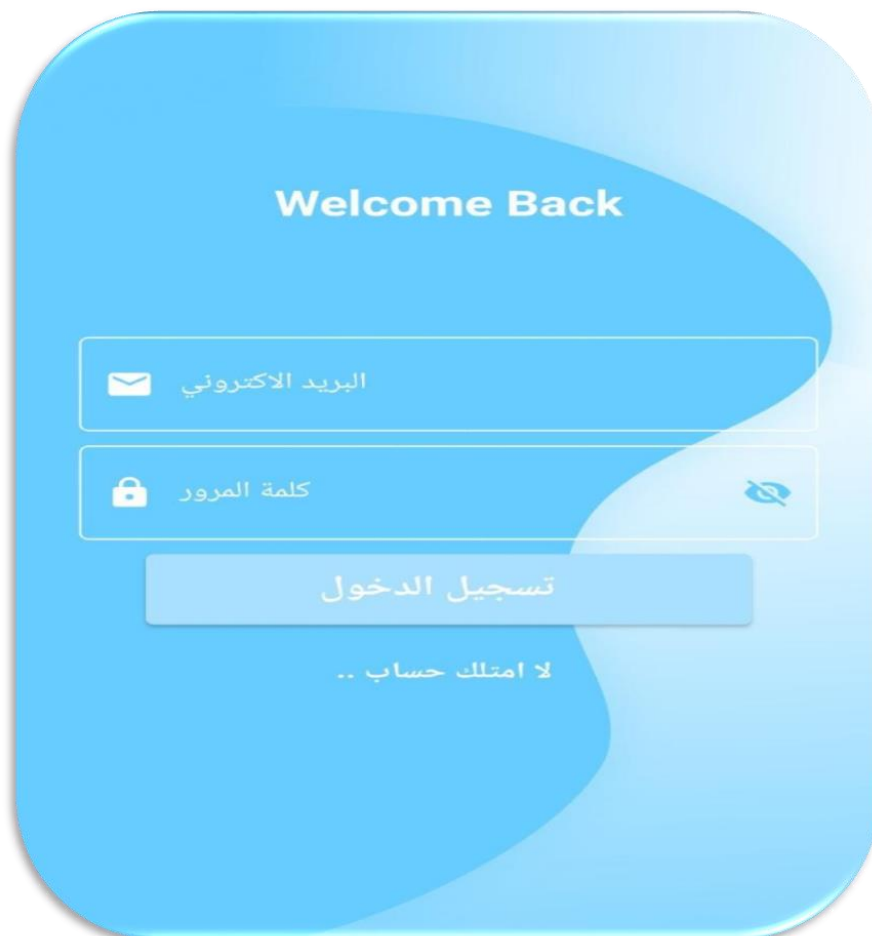
The loop continues until no new facts can be inferred, at which point the loop breaks and all the known facts are displayed using another f-string.

So, the overall purpose of this code is to perform inference on a set of logical rules and initial facts to infer new facts, using a forward chaining algorithm.

5.2 Application UI

• **Sign in Page:**

The login page allows the user to log into the application with his own account which he previously registered. If it is his first time using the app, he can click " I don't have an account " to send it to the new account registration page.

- **Sign up Page:**

    The Sign up page through which the user can register a new account in the application in order to be able to use the application , and when the Sign up button is pressed, the data is sent to firebase and thus he is able to log in to the application and on this page the user is required Enter each of (email - password)

- **Diagnosis page**

    The diagnosis page contains 21 questions. The user
    answers them with a yes or no, then presses the circle
    to send the answers and view diagnosis.

ساعدنا في تشخيص حالتك بشكل صحيح
[A, B]

فقد نسبيا قوه العضلات اثناء الاستخدام

لا

نعم

هل يستطيع استعمال العضله المصابه

لا

✓

ساعدنا في تشخيص حالتك بشكل صحيح
[A, B]

الم كضربه السكين

لا

نعم

فقد نسبيا قوه العضلات اثناء الاستخدام

لا

✓

ساعدنا في تشخيص حالتك بشكل صحيح
[A, B]

انقباض عضلى عنيف

لا

نعم

شد اكتر من اللازم ف العضله المصابه

لا

ساعدنا في تشخيص حالتك بشكل صحيح
[A, B]

التعب و الارهاق الشديد و انخفاض القدره
الجسديه

لا

نعم

انخفاض كفاءه العضله و قدرتها

لا

✓

ساعدنا في تشخيص حالتك بشكل صحيح
[A, B]

لا يمكن تحريك العضله المصابه

لا

نعم

انخفاض مستوى التوافق العضلى

لا

ساعدنا في تشخيص حالتك بشكل صحيح

[A, B]

شعور المريض بضعف العضلات و قله المرونه

لا

نعم

يشعر المريض بالتيبس عند الضغط عليه

لا

ساعدنا في تشخيص حالتك بشكل صحيح

[A, B]

نتيجه صدمه خارجيه او عنف خارجى
كالاصطدام بجسم صلب

لا

نعم

وجود تجمع دموى واضح حول مكان الاصابه
بعد **48** ساعه

لا

نعم

ساعدنا في تشخيص حالتك بشكل صحيح
[A, B]

هل تتغير درجه الحراره موضوعيا l

لا

نعم

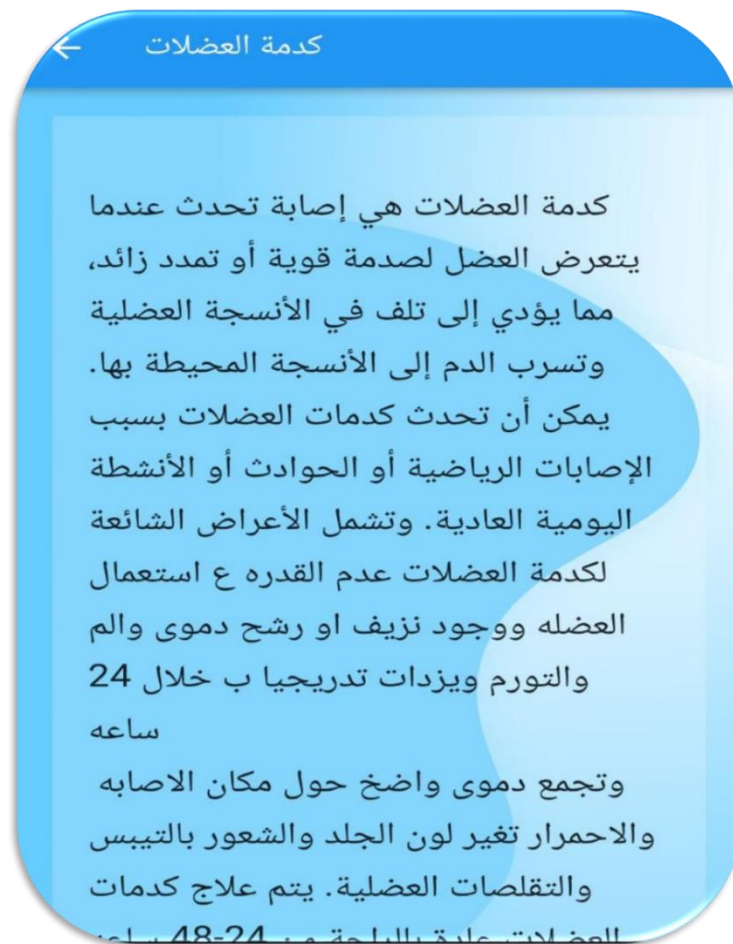هل تسطيع تحريك العضله المصابه

لا

✓

- **Notes page**

  The notes page contains 5 buttons, each of them pertaining
  to a specific injury, and when pressed, it displays a page
  containing information about the injury.

- **Contusion page**

  The page contains information about the Contusion injury and its severity

كدمة العضلات
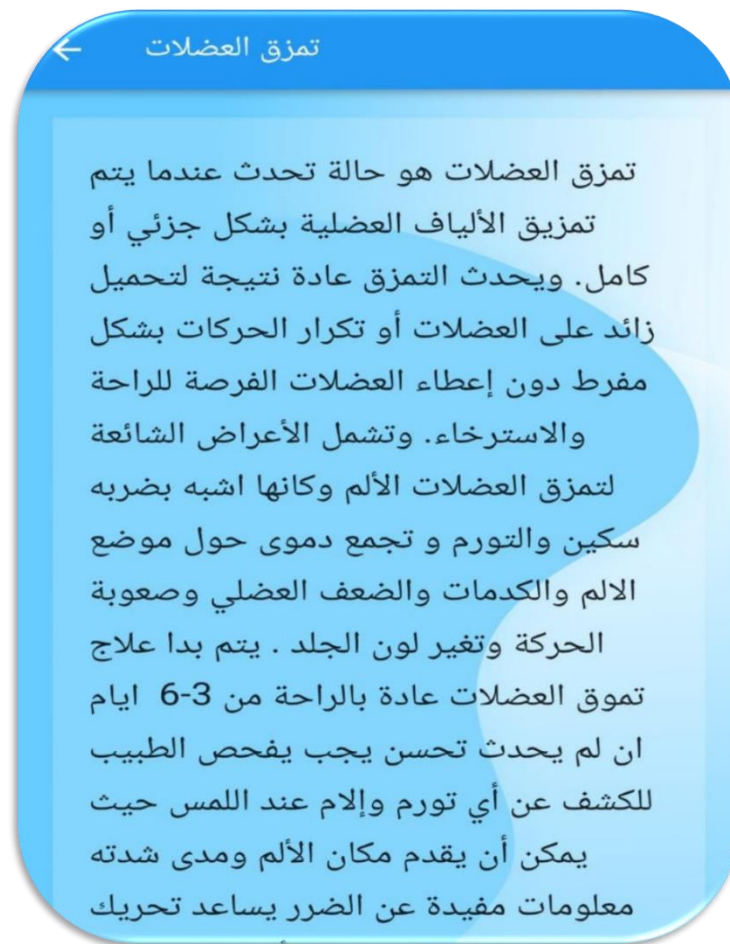
كدمة العضلات هي إصابة تحدث عندما
يتعرض العضل لصدمة قوية أو تمدد زائد،
مما يؤدي إلى تلف في الأنسجة العضلية
وتسرب الدم إلى الأنسجة المحيطة بها.
يمكن أن تحدث كدمات العضلات بسبب
الإصابات الرياضية أو الحوادث أو الأنشطة
اليومية العادية. وتشمل الأعراض الشائعة
لكدمة العضلات عدم القدره ع استعمال
العضله ووجود نزيف او رشح دموى والم
والتورم ويزدادت تدريجيا ب خلال 24
ساعه
وتجمع دموى واضخ حول مكان الاصابه
والاحمرار تغير لون الجلد والشعور بالتيبس
والتقلصات العضلية. يتم علاج كدمات
العضلات عادة بالراحة من 24-48 ساعه

- **Strain page**

    The page contains information about the Strain injury and its severity

شد العضلات

شد العضلات هو حالة تحدث عندما يتقلص العضل بشكل غير طبيعي ويسبب ألمًا حادًا وشديدًا. ويمكن أن يحدث الشد في العضلات نتيجة للتمارين الرياضية الشديدة أو التمدد الزائد للعضلات أو بسبب الإصابة بتمزق في العضلات. وتشمل الأعراض الشائعة للشد في العضلات الألم والتورم والحساسية ونزيف والضعف العضلي وتغير لون موضع الاصابه . يتم علاج الشد في العضلات عادة بالراحة من ٢-٤ ايام ووضع الثلج على المنطقة المصابة لتخفيف الألم وللتحسن التدريجي والحركة بعد فترة من الوقت، كما يمكن استخدام العلاج الطبيعي والتدريب على تقوية العضلات كجزء من العلاج وفى حاله عدم القدر ع التحمل
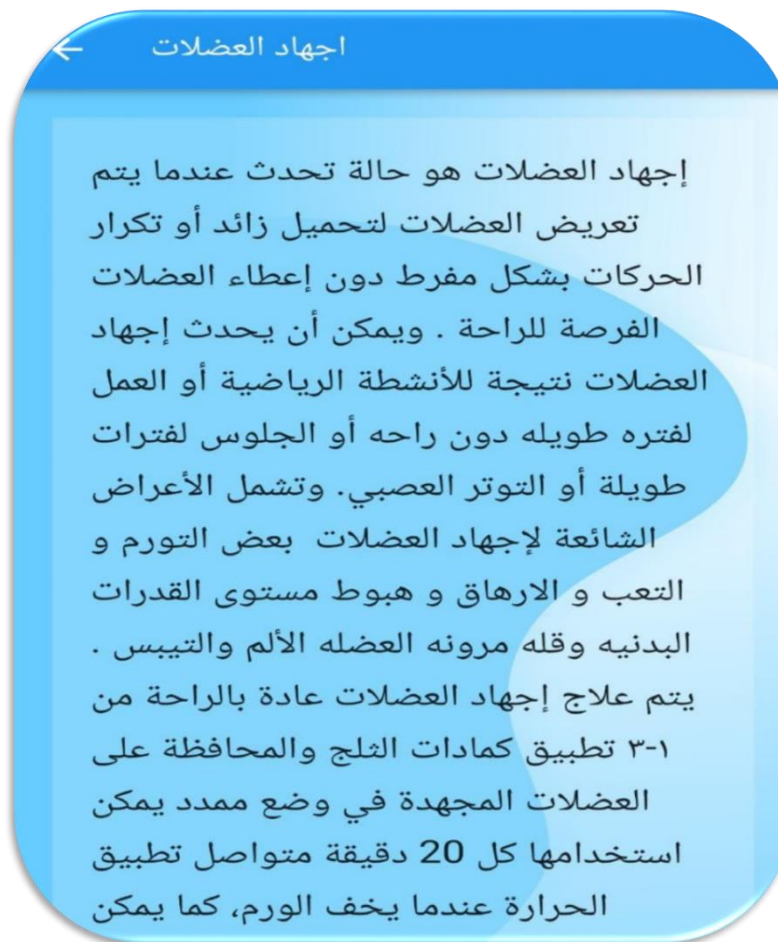
- **Tear page**

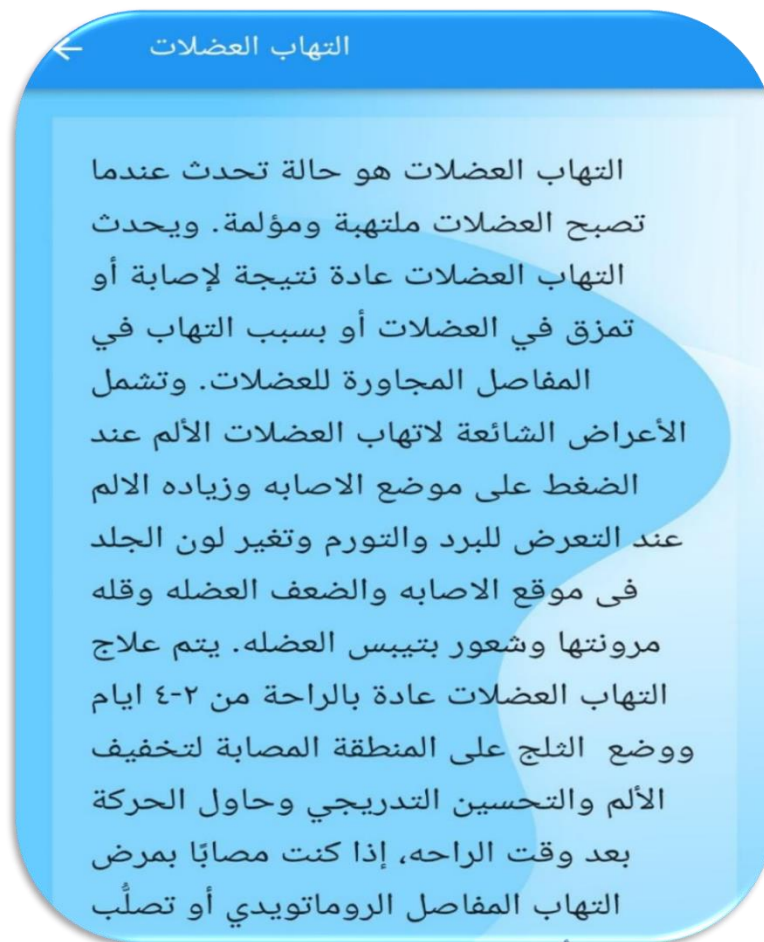   The page contains information about the Tear injury and its severity

تمزق العضلات

تمزق العضلات هو حالة تحدث عندما يتم تمزيق الألياف العضلية بشكل جزئي أو كامل. ويحدث التمزق عادة نتيجة لتحميل زائد على العضلات أو تكرار الحركات بشكل مفرط دون إعطاء العضلات الفرصة للراحة والاسترخاء. وتشمل الأعراض الشائعة لتمزق العضلات الألم وكانها اشبه بضربه سكين والتورم و تجمع دموى حول موضع الالم والكدمات والضعف العضلي وصعوبة الحركة وتغير لون الجلد . يتم بدا علاج تموق العضلات عادة بالراحة من 3-6 ايام ان لم يحدث تحسن يجب يفحص الطبيب للكشف عن أي تورم وإلام عند اللمس حيث يمكن أن يقدم مكان الألم ومدى شدته معلومات مفيدة عن الضرر يساعد تحريك

- **Strees page**

   The page contains information about the strees injury and
   its severity

اجهاد العضلات

إجهاد العضلات هو حالة تحدث عندما يتم
تعريض العضلات لتحميل زائد أو تكرار
الحركات بشكل مفرط دون إعطاء العضلات
الفرصة للراحة . ويمكن أن يحدث إجهاد
العضلات نتيجة للأنشطة الرياضية أو العمل
لفتره طويله دون راحه أو الجلوس لفترات
طويلة أو التوتر العصبي. وتشمل الأعراض
الشائعة لإجهاد العضلات بعض التورم و
التعب و الارهاق و هبوط مستوى القدرات
البدنيه وقله مرونه العضله الألم والتيبس .
يتم علاج إجهاد العضلات عادة بالراحة من
١-٣ تطبيق كمادات الثلج والمحافظة على
العضلات المجهدة في وضع ممدد يمكن
استخدامها كل 20 دقيقة متواصل تطبيق
الحرارة عندما يخف الورم، كما يمكن

- **inflammation page**

    The page contains information about the inflammation injury and its severity

التهاب العضلات

التهاب العضلات هو حالة تحدث عندما
تصبح العضلات ملتهبة ومؤلمة. ويحدث
التهاب العضلات عادة نتيجة لإصابة أو
تمزق في العضلات أو بسبب التهاب في
المفاصل المجاورة للعضلات. وتشمل
الأعراض الشائعة لاتهاب العضلات الألم عند
الضغط على موضع الاصابه وزياده الالم
عند التعرض للبرد والتورم وتغير لون الجلد
فى موقع الاصابه والضعف العضله وقله
مرونتها وشعور بتيبس العضله. يتم علاج
التهاب العضلات عادة بالراحة من ٢-٤ ايام
ووضع الثلج على المنطقة المصابة لتخفيف
الألم والتحسين التدريجي وحاول الحركة
بعد وقت الراحه، إذا كنت مصابًا بمرض
التهاب المفاصل الروماتويدي أو تصلُّب

5.3 Coding Front End (Flutter)

- **Coding for Diagnosis page**

```dart
105    Widget build(BuildContext context) {
106        Color optionButtonColor = ■Colors.white;
107        return Scaffold(
108            appBar: AppBar(
109                leading: IconButton(
110                    icon: const Icon(Icons.info),
111                    onPressed: () {
112                        Navigator.of(context).pushNamed("InfoPage");
113                    },
114                ), // IconButton
115                actions: [
116                    IconButton(
117                        onPressed: () {
118                            setState(() {
119                                setState(() {
120                                    listOfAnswerdCharacter.clear();
121                                });
122                            });
123                        },
124                        icon: const Icon(Icons.restart_alt)), // IconButton
125                    IconButton(
126                        onPressed: () {
127                            _showAlertDialogLogout();
128                        },
129                        icon: const Icon(Icons.exit_to_app)) // IconButton
130                ],
131                centerTitle: true,
132                title: const Text('تشخيص حالتك'),
133            ), // AppBar
134            body: constanrbackgroundstandartd(
135                context,
136                SafeArea(
137                    child: Column(
138                        children: [
139                            const Center(
140                                child: Text(
141                                    "ساعدنا في تشخيص حالتك بشكل صحيح"
```

```dart
145                    Center(
146                        child: Text(
147                            listOfAnswerdCharacter.toString(),
148                            style: const TextStyle(
149                                fontSize: 18, fontWeight: FontWeight.w300), // TextStyle
150                        ), // Text
151                    ), // Center
152                    Expanded(
153                        child: ListView.builder(
154                            itemCount: _questions.length,
155                            itemBuilder: (context, index) {
156                                return Card(
157                                    shape: const RoundedRectangleBorder(
158                                        borderRadius: BorderRadius.only(
159                                            topLeft: Radius.circular(50),
160                                            topRight: Radius.circular(50),
161                                    )), // BorderRadius.only // RoundedRectangleBorder
162                                    margin: const EdgeInsets.symmetric(
163                                        horizontal: 20, vertical: 20), // EdgeInsets.symmetric
164                                    elevation: 15,
165                                    child: Container(
166                                        width: double.infinity,
167                                        height: 300.0,
168                                        padding: const EdgeInsets.all(40),
169                                        decoration: BoxDecoration(
170                                            borderRadius: BorderRadius.circular(5.0),
171                                        ), // BoxDecoration
172                                        child: Center(
173                                            child: Column(
174                                                children: [
175                                                    Text(
176                                                        _questions[index]['question'].toString(),
177                                                        textAlign: TextAlign.center,
178                                                        style: const TextStyle(
179                                                            fontSize: 17.0,
180                                                            color: □Colors.black,
181                                                            fontWeight: FontWeight.bold,
182                                                        ), // TextStyle
```

```dart
                        // ),
                        //code of options
                        ...(_questions[index]['answers']
                                as List<Map<String, Object>>)
                            .map(
                          (answer) => Answer(
                            answerText: answer['answerText'].toString(),
                            answerColor: (answer['answerText'] == "نعم")
                                ? mainColor
                                : Colors.black26,
                            answerTap: () {
                              // if answer was already selected then nothing happen
                              if (answerWasSelected) {
                                return;
                              }
                              //answer is being selected
                              if (answer['score'] == "") {
                                print("no thing");
                              } else {
                                //in case click yes
                                if (listOfAnswerdCharacter
                                    .contains(answer['score'])) {
                                  print("exist");
                                } else {
                                  // chosenCharacters.add(answer['score']);
                                  setState(() {
                                    listOfAnswerdCharacter
                                        .add(answer['score']);
                                  });
                                }
                              }
                              // _questionAnswered(answer['score']);
                            },
                          ), // Answer
                        ),
                      ],
                    ), // Column
                  ), // Center
```

```dart
                  ),
                  floatingActionButtonLocation: FloatingActionButtonLocation.centerFloat,
                  floatingActionButton: FloatingActionButton(
                    backgroundColor: mainColor,
                    child: const Icon(Icons.done),
                    onPressed: () {
                      //show list of characters
                      print("list of characters : $listOfAnswerdCharacter");
                      //code of machine learing
                      // var initialFacts = ['B', 'K', 'A', 'F', 'G', 'H', 'I'];
                      var initialFacts = listOfAnswerdCharacter;
                      var tempFacts = Set<String>.from(initialFacts);
                      var rules = [
                        {
                          'code': 'R1',
                          'conditions': ['B', 'K'],
                          'conclusion': 'q'
                        },
                        {
                          'code': 'R2',
                          'conditions': ['A', 'F'],
                          'conclusion': 'B'
                        },
                        {
                          'code': 'R3',
                          'conditions': ['F', 'G'],
                          'conclusion': 'H'
                        },
                        {
                          'code': 'R4',
                          'conditions': ['H'],
                          'conclusion': 'B'
                        },
                        {
                          'code': 'R5',
                          'conditions': ['G', 'I'],
                          'conclusion': 'H'
                        },
```

lib > home > homePage.dart > _HomeState

```dart
        ];
        var executedRules = Set<String>();

        while (true) {
          var newFacts = <String>{};
          for (var rule in rules) {
            if ((rule['conditions'] as List<String>)
                .every(tempFacts.contains)) {
              newFacts.add(rule['conclusion'].toString());
              executedRules.add(rule['code'].toString());
            }
          }
          if (newFacts.difference(tempFacts).isEmpty) {
            break;
          }
          tempFacts.addAll(newFacts);
        }

        print('Executed rules:');
        print(executedRules);

        print('All available facts:');
        print(tempFacts);

        if (tempFacts.contains('s') &&
            {'R3', 'R4', 'R7', 'R8', 'R9', 'R10'}
                .intersection(executedRules)
                .isNotEmpty) {
          print("التشخيص تمزق فالعضلات");
          showsnackbarmassgae(Icons.info, "التشخيص تمزق فالعضلات");
        } else if (tempFacts.contains('x') &&
            ({'R11', 'R13', 'R12'}.intersection(executedRules).isNotEmpty ||
                {'R11', 'R12', 'R14'}
                    .intersection(executedRules)
                    .isNotEmpty)) {
          print("التشخيص التهاب فالعضلات");
          showsnackbarmassgae(Icons.info, "التشخيص التهاب فالعضلات");
```
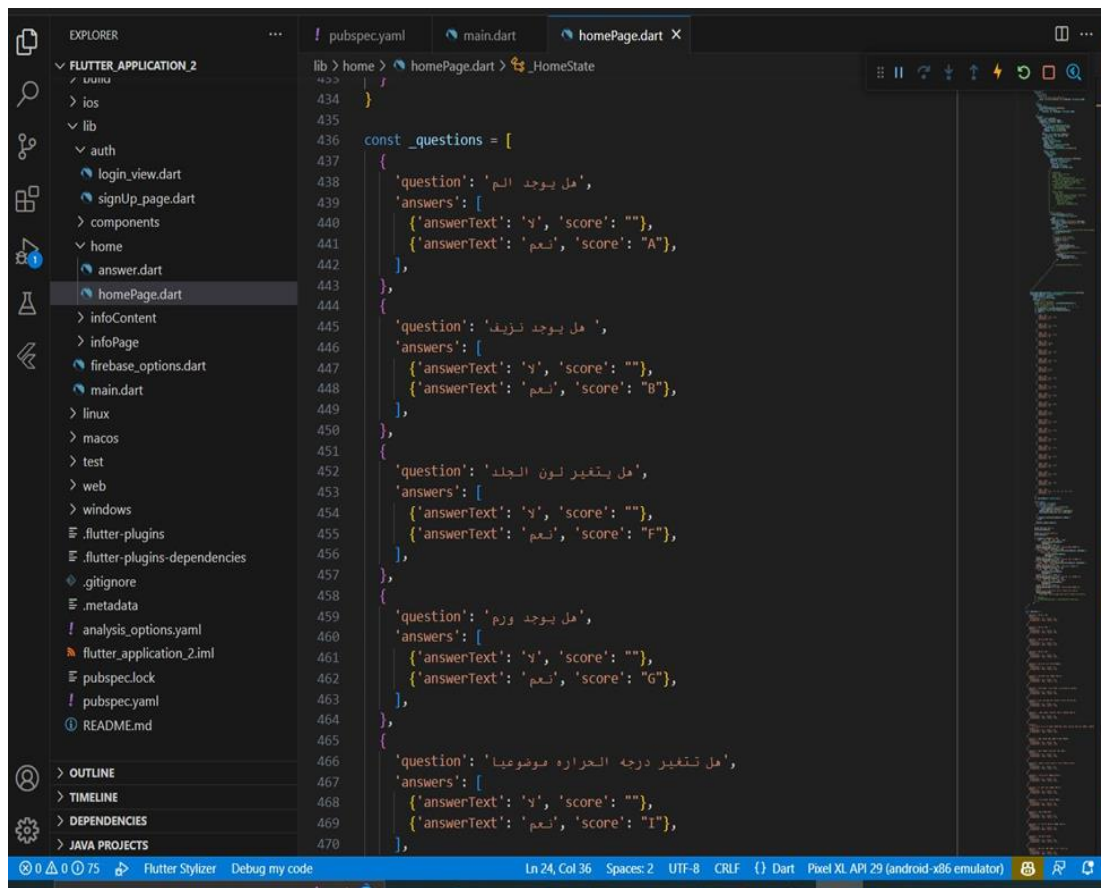
lib > home > answer.dart > _AnswerState > build

```dart
    class Answer extends StatefulWidget {
      late String answerText;
      late Color answerColor;
      Color? yesButtonColor;
      Color? NoButtonColor;
      final answerTap;

      Answer({required this.answerText, required this.answerColor, this.answerTap});
      @override
      State<Answer> createState() => _AnswerState();
    }

    class _AnswerState extends State<Answer> {
      @override
      Widget build(BuildContext context) {
        return Expanded(
          child: SizedBox(
            height: 20,
            child: OutlinedButton(
              style: ElevatedButton.styleFrom(
                backgroundColor: (widget.answerColor == mainColor)
                    ? widget.yesButtonColor
                    : widget.answerColor,
                shape:
                    RoundedRectangleBorder(borderRadius: BorderRadius.circular(20)),
                elevation: 4.0,
              ),
              onPressed: () {
                setState(() {
                  // last_match = true;

                  if (widget.answerText == "نعم") {
                    widget.yesButtonColor = mainColor;
                    widget.NoButtonColor = buttonSecondColor;
                  }
                  widget.answerTap();
                });
```
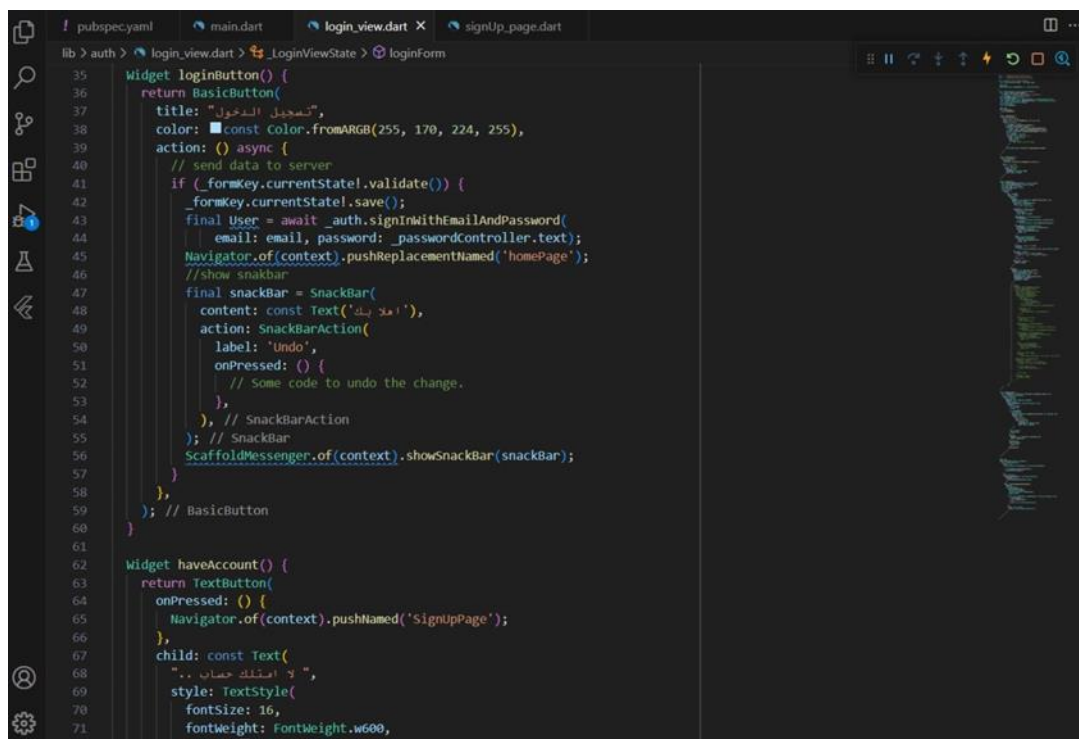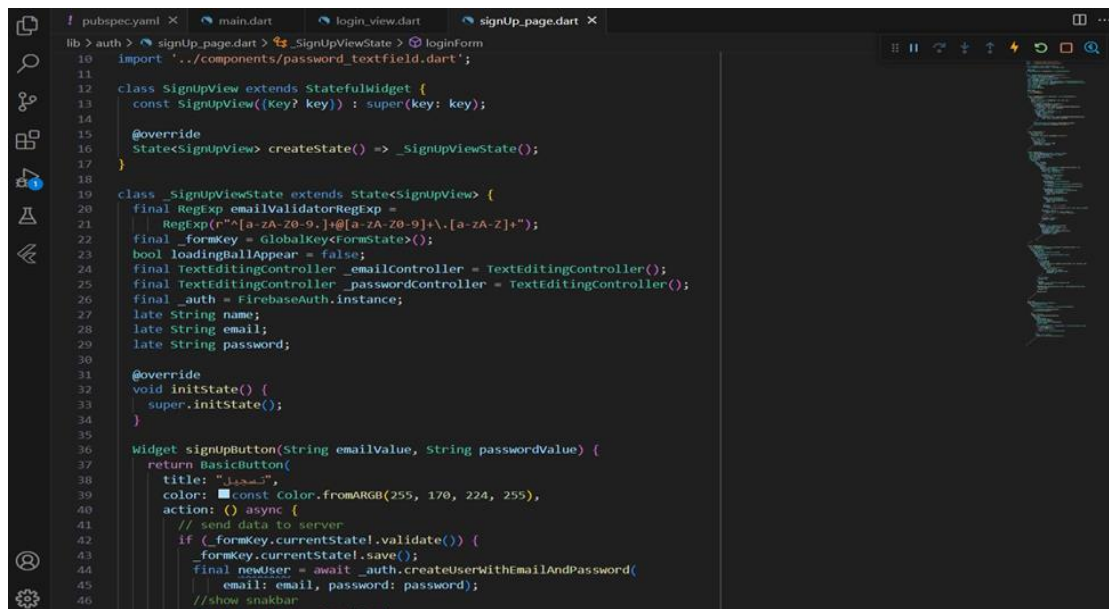
- **Coding for Sign in Page**

lib > auth > login_view.dart > _LoginViewState > loginForm

```dart
78    Widget loginForm() {
79      Color textfieldBorderFocusColor = Colors.white;
80      Color textfieldBorderColor = Colors.white;
81      FocusNode node = FocusNode();
82      bool passwordVisible = false;
83      return Column(
84        children: [
85          Form(
86            key: _formKey,
87            child: Column(
88              children: [
89                Padding(
90                  padding: const EdgeInsets.symmetric(horizontal: 10),
91                  child: TextFormField(
92                    controller: _emailController,
93                    style: const TextStyle(
94                      // color: Colors.white,
95                    ), // TextStyle
96                    decoration: InputDecoration(
97                      prefixIcon: const Icon(
98                        Icons.email,
99                        color: Colors.white,
100                     ), // Icon
101                     enabledBorder: OutlineInputBorder(
102                       borderRadius:
103                         const BorderRadius.all(Radius.circular(5.0)),
104                       borderSide:
105                         BorderSide(color: textfieldBorderFocusColor),
106                     ), // OutlineInputBorder
107                     focusedBorder: OutlineInputBorder(
108                       borderRadius: BorderRadius.circular(25.0),
109                       borderSide: BorderSide(
110                         color: textfieldBorderColor,
111                         width: 1.5,
112                       ), // BorderSide
113                     ), // OutlineInputBorder
114                     border: OutlineInputBorder(
```

lib > auth > login_view.dart > _LoginViewState > loginForm

```dart
215
216    Widget bodyBuilder() {
217      final iskeyboard = MediaQuery.of(context).viewInsets.bottom != 0;
218      return SingleChildScrollView(
219        child: SafeArea(
220          child: Padding(
221            padding: const EdgeInsets.all(20),
222            child: Column(
223              mainAxisAlignment: MainAxisAlignment.center,
224              children: [
225                const SizedBox(
226                  height: 90,
227                ), // SizedBox
228                if (!iskeyboard)
229                  const Padding(
230                    padding: EdgeInsets.symmetric(horizontal: 20, vertical: 10),
231                    child: Center(
232                      child: Text(
233                        "Welcome Back",
234                        style: TextStyle(
235                          fontSize: 25,
236                          fontWeight: FontWeight.bold,
237                          color: Colors.white), // TextStyle
238                      ), // Text
239                    ), // Center
240                  ), // Padding
241                const SizedBox(
242                  height: 20,
243                ), // SizedBox
244                Padding(
245                  padding: const EdgeInsets.only(top: 50),
246                  child: loginForm(),
247                ), // Padding
248                loginButton(),
249                const SizedBox(
250                  height: 10,
251                ), // SizedBox
252                haveAccount(),
```

- **Coding for Sign up Page**

```dart
79
80    Widget loginForm() {
81      Color textfieldBorderFocusColor = Colors.white;
82      Color textfieldBorderColor = Colors.white;
83      FocusNode node = FocusNode();
84      bool _passwordVisible = false;
85      return Column(
86        children: [
87          Form(
88            key: _formKey,
89            child: Column(
90              children: [
91                Padding(
92                  padding: const EdgeInsets.symmetric(horizontal: 10),
93                  child: TextFormField(
94                    controller: _emailController,
95                    style: const TextStyle(
96                      // color: Colors.white,
97                    ), // TextStyle
98                    decoration: InputDecoration(
99                      prefixIcon: const Icon(
100                       Icons.email,
101                       color: Colors.white,
102                     ), // Icon
103                     enabledBorder: OutlineInputBorder(
104                       borderRadius:
105                         const BorderRadius.all(Radius.circular(5.0)),
106                       borderSide:
107                         BorderSide(color: textfieldBorderFocusColor),
108                     ), // OutlineInputBorder
109                     focusedBorder: OutlineInputBorder(
110                       borderRadius: BorderRadius.circular(25.0),
111                       borderSide: BorderSide(
112                         color: textfieldBorderColor,
113                         width: 1.5,
114                       ), // BorderSide
115                     ), // OutlineInputBorder
116                     border: OutlineInputBorder(
```

```dart
155      final iskeyboard = MediaQuery.of(context).viewInsets.bottom != 0;
156      return SingleChildScrollView(
157        child: SafeArea(
158          child: Padding(
159            padding: const EdgeInsets.all(20),
160            child: Column(
161              mainAxisAlignment: MainAxisAlignment.center,
162              children: [
163                const SizedBox(
164                  height: 80,
165                ), // SizedBox
166                if (!iskeyboard)
167                  const Padding(
168                    padding: EdgeInsets.symmetric(horizontal: 20, vertical: 10),
169                    child: Center(
170                      child: Text(
171                        "Sign Up \n join to us !!",
172                        style: TextStyle(
173                          color: Colors.white,
174                          fontWeight: FontWeight.bold,
175                          fontSize: 28), // TextStyle
176                      ), // Text
177                    ), // Center
178                  ), // Padding
179                const SizedBox(
180                  height: 20,
181                ), // SizedBox
182                Padding(
183                  padding: const EdgeInsets.only(top: 50),
184                  child: loginForm(),
185                ), // Padding
186                signUpButton(_emailController.text, _passwordController.text),
187                const SizedBox(
188                  height: 10,
189                ), // SizedBox
190                haveAccount(),
191              ],
```

- **Coding for Notes page**

```dart
lib > infoPage > info.dart > _InfoPageState > build

 4    import 'package:flutter_application_2/components/constant.dart';
 5
 6    import '../components/background/constants_args.dart';
 7    import '../components/cardButton.dart';
 8    import '../infoContent/infoContentPage.dart';
 9
10    class InfoPage extends StatefulWidget {
11      const InfoPage({super.key});
12
13      @override
14      State<InfoPage> createState() => _InfoPageState();
15    }
16
17    class _InfoPageState extends State<InfoPage> {
18      String text5 =
19          " العضله ووجود نزيف او رشح دموى والم والتورم ويزدات تدريجيا ب خلال 24 ساعه\n "
20      String text55 =
21          "\n ورم الناتج عن الإصابة وفى عدم وجود تحسن بعد اقصى 4 ايام يرجى مراجعه الطبيب"
22      @override
23      Widget build(BuildContext context) {
24        return Scaffold(
25          appBar: AppBar(
26            title: const Text("ملاحظات للاصابات"),
27          ), // AppBar
28          body: constanrbackgroundstandartd(
29            context,
30            Padding(
31              padding: const EdgeInsets.all(40),
32              child: GridView.count(
33                crossAxisCount: 2,
34                crossAxisSpacing: 4.0,
35                mainAxisSpacing: 2.0,
36                children: [
37                  CardButton(
38                    title: "شد العضلات",
39                    color: mainColor,
40                    imagePath: "assets/muscle (1).png",
```

```dart
lib > infoPage > info.dart > _InfoPageState > build

50              ), // CardButton
51              CardButton(
52                title: "التهاب العضلات",
53                color: mainColor,
54                imagePath: "assets/muscle.png",
55                func: () {
56                  Navigator.of(context).push(MaterialPageRoute(
57                    builder: (context) => InfoContent(
58                      title: "التهاب العضلات",
59                      content:
60                          "نه يزيد خطر فاصابة بالتهاب العضلات ويرجى مراجعه طبيب وقتها"
61                    ), // InfoContent
62                  )); // MaterialPageRoute
63                },
64              ), // CardButton
65              CardButton(
66                title: "تمزق العضلات",
67                color: mainColor,
68                imagePath: "assets/body.png",
69                func: () {
70                  Navigator.of(context).push(MaterialPageRoute(
71                    builder: (context) => InfoContent(
72                      title: "تمزق العضلات",
73                      content:
74                          "ناك ضرر في الأربطة أو الأوتار ووقتها يتم وضع برنامج للتاهيل"
75                    ), // InfoContent
76                  )); // MaterialPageRoute
77                },
78              ), // CardButton
79              CardButton(
80                title: "اجهاد العضلات",
81                color: mainColor,
82                imagePath: "assets/sprain.png",
83                func: () {
84                  Navigator.of(context).push(MaterialPageRoute(
85                    builder: (context) => InfoContent(
86                      title: "اجهاد العضلات",
87                      content:
```

- **Firebase**

Future work :

1) We will add the chatbot
2) We supply the rest of the injuries
3) Provide some diagnostics
4) We will put search for other injuries
5) We put a search for doctors
6) We put additional exercises to help the patient more
7) The patient can put a picture of the rays required of him for the program so that the program can examine and diagnose it

- **References:**

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17) https://ojs.aaai.org/index.php/ICAPS/article/view/13403

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19) https://www.cs.utep.edu/cheon/techreport/tr20-95.pdf

20) https://jutif.if.unsoed.ac.id/index.php/jurnal/article/view/150