

UNIVERSITY OF CAPE COAST

EFFECT OF ENDORPHIN RELEASE THERAPY ON PAIN AND RANGE OF  
MOTION OF INJURED SENIOR HIGH SCHOOL ATHLETES IN CENTRAL  
REGION, GHANA

BERNARD KORSAH

2018

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REGION, GHANA

BY

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Thesis submitted to the Department of Health Physical Education and  
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of Education Studies, University of Cape Coast, in partial fulfilment of the  
Requirements for the award of Doctor of Philosophy Degree in Physical  
Education (Sports and Exercise Science)

SEPTEMBER 2018

## DECLARATION

### Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature ..... Date .....

Name: Bernard Korsah

### Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature ..... Date .....

Name: Prof. Leah O. Dominic

Co-Supervisor's Signature ..... Date.....

Name: Dr. Daniel Apaak.

## ABSTRACT

The purpose of this study was to examine the effect of Endorphin Release Therapy (ERT) on pain and Range of Motion (ROM) of joints among injured Senior High School (SHS) athletes in the Central Region of Ghana. A purposive sample of 62 SHS injured athletes from the Central Region participated in the quasi-experimental study. Quantitative data were collected by the use of an orthopedic mobility scanner; a standard goniometer and 0-10 Numerical Rating Scale. The reported intra examiner reliability coefficient of the instruments mentioned are .98, .96 and .98 respectively (Bermingham, 2003; Williams, Davies, & Chadury, 2000). Frequencies and percentages were used to answer the four (4) research questions. The dependent paired sample t-test and multivariate ordered logistic regression were used to analyze the three research hypotheses of the study at an alpha level of 0.05. The major findings of the study were that ERT is very effective in the relief of traumatic pain, as well as in the improvement of ROM of injured joints of SHS athletes of Central Region, Ghana. With the consideration of effect sizes, ERT proved to be more effective in the management of traumatic pain than in the management of restricted ROM of injured joints. As recommendation, ERT should be considered and put into in the curriculum of medical doctors, sports therapist, physical education teachers, and others, since it could help in reducing chronic traumatic pains. Further studies on the effectiveness of ERT in the management of other prevalent sports related injuries and diseases such as stroke and heart attack is suggested.

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**DEDICATION**

To my beloved late brothers, Richard and Stephen Korsah.

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## CHAPTER ONE

### INTRODUCTION

#### **Background to the Study**

Pain and limited range of motion (ROM) have been major characteristics of most traumatic sports injuries suffered by sportsmen and sportswomen of all categories (Sprinkle, 2014). The fact is that, repetitive motions including seemingly harmless activities like walking, running and swimming, produce micro-trauma which is considered as an impetus for the body to make progress in performance. Going beyond this micro-trauma point by means of vigorous training with increased intensity naturally causes serious trauma that brings about injuries (Bessa, 2008).

The vigorous use of the body during training, coupled with the passion and competitive spirit of winning at-all-cost, in most cases, end up with an individual suffering from a painful traumatic injury. The pain of the traumatic injury sustained leads to a certain degree of reduction in ROM. According to Dudick (2014), a trauma surgeon at Atlantic Care Regional Medical Center in Atlantic City, New Jersey, at the cellular level, trauma promotes pain and inflammation to limit ROM of affected or related joint.

Sprinkle (2014) has revealed that the 10 top most dangerous sports, ranked according to total injuries in 2012 were American football (394,350), basketball (389,610), soccer (172,470), baseball (119,810), volleyball (43,190), wrestling (40,750), gymnastics (28,300) and finally athletics (24,910). It is interesting to know that the most prevalent sports related injuries among the statistics

mentioned above could be classified as sprain and strain. A sprain is a ligamentous injury at a joint. A sudden twisted or overstretched ligament during landing, pivoting, running or kicking a ball may cause a sprain. A strain is a musculo-tendinous injury which may occur when a tendon is overstretched, over used or stressed during a physical activity (Bradford, 2017). In the year 2011 to 2013, records have revealed that 34% of musculo-skeletal injuries from individual sports activities treated in the United States Emergency Department were sprain and strain. Sixty percent of athletics injuries were also made up of sprain and strain (Rosenfield, 2014). However, pain and joint stiffness (limited ROM) are the main signs and symptoms of these two injuries. A footballer who lands badly to sprain the foot may scream to indicate a painful injury. Another player may not be able to stand upright, or straighten injured knees because of pain and restricted ROM (Dudick, 2014; Tuzun, 2007).

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage (International Association for the Study of Pain [IASP], 2014). It is considered as the most prevalent musculo-skeletal condition which most people suffer from, in all continents and economies. Pain is the prominent symptom of most diseases and injuries which motivates people to seek health care. It is also the leading cause of disability and poor sports performance, and a major contributor to healthcare cost in the United States. It is on record that chronic pain affects more Americans than diabetes, heart disease and cancer combined (Institute of Medicine of The National Academies, 2017; NIH, 2016). Without pain, health problems like arthritis, osteoporosis, cancer, stomach ache,



tooth ache, muscle cramps, sprain and strain, would have been no burden (Tuzun, 2007). A study conducted by Hill (2000) revealed that over 120 million people suffer from chronic pain. They lose about 50 million working hours each year. According to a national survey conducted by the National Center for Health Statistics (2006), approximately 76.2 million people, including sportsmen and women, have suffered pain that lasted longer than 24 hours, and as a result lost 149.1 million workdays. Professional players in this category then became problems to their teams. According to Cumps (2007), a total direct medical cost inferred for Flemish sports participants annually is about €15,027,423; 0.08% of the country's expenditure on health care. An indirect Cost of €111,420,813, being about 3.4% of the cost due to absenteeism from work was also realized.

The vicious socio-economic impact of sports injuries is also felt in the Netherlands where €3.5 billion is spent on sports injuries annually (Polinder et al., 2016). In Switzerland cost of medical treatment of an injury in football is about 150 US Dollars. However about 40,000 football injuries occur in a year, resulting in the loss of 500,000 working days. The monetary equivalent of the lost working days was estimated to be 20 million Swiss Francs in 2003, approximately 87 million US Dollars (Korkmaz, Kihç, Çatikkas & Yucel, 2014).

. Apart from high treatment cost, poorly managed sports injuries have also prematurely ended the career of many talented Ghanaian football players such as Osei Kofi, Ali Jara and Steven Appiah (Mock, Abantanga, Cummings & Koepsell, 1999). During the 2018 Athletics Qualifying Championship organized by Ghana Athletics Association at Cape Coast, Vivian Mills, a 400m champion

could not run the finals race due to a painful strain she sustained around the scapular during the heats race. According to the Ghana National Fire Service coach, she was therefore not selected for the 2018 Commonwealth Games held in Gold Coast, Australia.

The adverse effects of musculo-skeletal injuries are also experienced by most Senior High School (SHS) athletes in Central Region. During the 2016 Super-zonal Athletics Championship Mfantshipim School and St. Augustine's College lost the services of their best high jumper and best distance runner respectively due to pain and restricted ROM of injuries they sustained during their zonal level competition (Central Region Schools and Colleges Sports Federation Medical Team, 2016).

Records of the Central Region Schools and Colleges sports medical team have revealed that the prevalence level of joint sprain and strain is usually high during the athletics season of the second cycle schools. This may be due to the relatively short sports season, overuse, poor training methods, usage of inappropriate equipment, poor warm-up, and weakness of muscles, tendons and ligaments (Prezi, 2012).

Despite the negative side of pain, O'Connor (2007) has stated that pain provides valuable information about the body and how it is performing. Therefore, an athlete's ability to tolerate and manage pain is essential for success.

Range of motion or flexibility is among the least recognized component of health-related physical fitness. It is been defined as the range through which a

joint can be moved, usually its range of flexion and extension, as determined by the type of joint, its articular surfaces, and that allowed by regional muscles, tendons, ligaments, joints and physiological control of movement across the joint (Bennett, Schenk & Simmons 2002). Thus ROM determines the degree of movement at every joint, whether during flexion, extension, adduction, abduction or circumduction. Each joint has its own level of flexibility, expressed in degrees. Range of motion is important because it contributes significantly to injury prevention, general health and better sports performance (Yazici, Pincus, Kautianen, & Solka 2004). A volleyball player, for example, will need flexible shoulders, elbows, wrists and fingers to enable him or her to perform all the skills needed to play the game successfully (Winsper, 2016). Active ROM of body parts is also important for routine activities of daily living. In a study conducted by Bennett, Schenk and Simmons (2002), the following greatest full active ROM utilized in the cervical spine to perform some functional routine activities were established. For the tying of shoe laces, backing up a car, washing hair in the shower, and crossing a street, 66.7° flexion and extension, 67.6° rotation, 42.9° flexion-extension, and 31.7° head rotation to the left and to the right were utilized respectively.

Range of motion is limited by factors like joint structure, fat tissue at the joint, body temperature, activity level, gender, age and genetics, but musculo-skeletal injury is a major one (Stoppler, 2015). For example, a sprain is a weak, painful and inflamed joint of limited ROM. The limited ROM manifests due to injured ligaments associated with inflammation and pain leading to poor

physiological control of joint movement. With a limited ROM and the feeling of pain, no serious activity could be done in competitive sports (Bessa, 2008). For instance, a high jumper with a limited ROM at the back and hip joints will not be successful with the use of the flop style. Also, a limited ankle-dorsiflexion ROM may contribute to ankle, foot and knee injuries including plantar fasciitis, ankle sprains, tight calf muscles, Achilles tendinitis, fore foot pain, anterior cruciate ligament injury and others (Jeon, In-Cheol, kwon, Oh-yun, Yi, Chung-Hwi, Cynn, Heon-Seock & Hwang, 2015).

As people experience the burden of pain and limited ROM, they may initiate a number of strategies to reduce the burden. Because of its efficacy, the use of ice has been recommended for the management of pain of traumatic sports injuries (Berkerman (2014) and Grisogono (2009). Ice has the ability to produce the required anaesthetic effect to numb off the pain of any injured part of the body, and also to break the muscle-pain- muscle - spasm cycle to reduce traumatic pain (Adams, 2014; University of Rochester Medical Centre, 2015). Despite the effectiveness and popular usage of ice, it has problems. The application of ice could lead to the impairment of reflex activity and motor function (Beckerman, 2014). There are also reported cases of the feeling of unusual sensations, such as numbness, tingling, redness and irritation of the skin as well (Stoppler, 2015). Adams (2014) has also reported that Ice therapy could increase heart rate and breathing rate, leading to loss of co-ordination and confusion due to the constriction of blood vessels. There is also some amount of reduction in the elasticity of soft tissues and flexibility at the joint when ice is

applied to such areas of the body. The sudden death of Chelsea Patricia Ake-Salvacion in a cryotherapy chamber, with the Police confirming no suspicious act, may confirm the adverse effect of ice on the physiological function of the body (Carroll, 2015).

Apart from the above, other problems limiting the use of ice as a therapeutic modality were also revealed during discussion at the maiden International Conference on Sports Physical Therapy and Rehabilitation (ICONSPT REHAB, 2018) held in Accra, Ghana. Lack of knowledge on the part of first-aiders, self-styled sports therapists, masseurs and some sports coaches in the effective application of ice were mentioned as some of the reasons limiting the use of ice. Most athletes do not also allow the ice treatment to go through the required phases and duration due to the unpleasant feeling experienced during the second phase of the treatment. Though the recommended time for the application of ice is 20 minutes (Berkerman, 2014; Stoppler, 2015), some sports therapists and coaches allow ice packs to stay on injured parts of the body for about an hour. According to Stoppler (2015) this practice has a serious adverse effect on muscle fibres and performance. The unavailability of portable ice block storage materials and lack of different forms of ice mediums such as chemical and gel ice packs, vapour-coolants were cited as other limitations to the usage of ice in many countries including Ghana (ICONSPT REHAB, 2018).

Apart from seeking medical attention, people with chronic pain usually use a variety of self-care approaches including the application of ointments or liniments, changing of position, massage, pressure or vibration, cold compress,

meditation or prayer, watching television, talking with someone, laughing, soaking in a Jacuzzi or hot tub, mild exercise and listening to cool music (Hansen, 2013). Pain patients also use complementary and alternative medicine (CAM). Acupressure, acupuncture, chiropractic, massage, reflexology, and relaxation care are some of the popular pain relieving methods under CAM (National Center for Complementary and Alternative Medicine, 1999).

In recent times, a relatively new therapy known as Endorphin Release Therapy (ERT) is also being used to manage sports injuries successfully. Endorphin Release Therapy is similar to acupressure in practice. Finger tips are used to manipulate nerves or pain points around an injured part of the body to stimulate and direct the flow of released endorphins to relief pain, just as the meridians of the body will be followed with finger pressure in acupressure to promote healing (Carty, 2006; Gala, 2004). Endorphin release therapy is a natural therapy that excites the body to heal itself. No side effect has been recorded so far apart from an initial slight pain felt when the pain points or pressure points are touched. The therapy does not require any preparatory medical examination or test, and no tool or an instrument is needed to perform the therapeutic modality. ERT can also be administered anytime and everywhere at a relatively lower cost. A minimum time of about 20 to 30 minutes is needed to complete a session (Carty, 2006). Appreciation letters from some treated clients of the Endorphin Release therapy clinic in Dublin, Ireland, could be cited as evidence proving the efficacy of ERT. Bean O’Kelly, an author, sent an appreciation letter to the clinic for relieving his back pain before he could sit to

complete writing his book titled “327 Ocean Street, a home away from home”. A letter received from Katie Murphy, a dancer who nearly missed the 2003 Dublin Championship due to painful knee, expressed how ERT helped her to compete and won the championship. Sean Moylan, after climbing Mountain Kilimanjaro at 5895m and -35 degree Celsius, wrote to the ERT clinic thanking them for working on his painful neck and back, which were serious hindrance to his performance (Endorphin Release Therapy Clinics Ltd., 2014). Letters of appreciation written by Professor Puffah and Doctor Boateng, former lecturers of the Departments of Health, Physical Education and Recreation, of University of Education, Winneba, and University of Cape Coast, respectively, are local evidence of ERT (see Appendices A & B for the letters written).

Endorphin Release Therapy has also been used by some members of medical teams headed by Dr. K.K. Azeez, a former Director of Health and Medical Services at the University of Cape Coast, for the management of sports injuries of students during Central Region schools and colleges sports festivals, University of Cape Coast inter-halls sporting competitions and Ghana University sports association (GUSA) games. Observations were that injured athletes and game players treated with ERT returned to active participation, in most cases, earlier than those treated with the traditionally known methods; application of cryotherapy, thermotherapy and massaging. This calls attention to the use of ERT.

Meanwhile, stretching has been the recommended modality to improve ROM, but in recent times, literature has showcased various means used to

improve limited ROM. A research conducted by Mitra, Harris and Fredericson (2009) to examine the short-term efficacy of a new protocol consisting the administration of a suprascapular nerve blocker, an injection of an anaesthetic agent with normal saline volume dilation, and the manipulation of the shoulder, as the final step to manage adhesive capsulitis, is a good example. The findings of the study suggested that the adhesive capsulitis management protocol is effective and produces a significant improvement in the passive ROM immediately after the procedure.

### **Statement of the Problem**

Contemporary literature on sports injuries has indicated that sprain and strain, which comes with pain and restricted ROM, are the most prevalent sports injuries (Cunha, 2017; Korkmaz et al., 2014; Mair, 2014; Stanford Children's Health, 2016). According to the U.S. National Electronic Injury Surveillance System (NEISS), ankle sprain is the single most common injury in football and basketball. Out of the total of 239,943 injuries treated at the U.S. hospital emergency rooms, 79,384 were sprain and strain (Health City Islands, 2018).

Extant literature has made it clear the limiting effects pain and restricted ROM have on sports performance and general functional ability, despite the huge socio-economic burden on countries and individuals, especially those in competitive sports. Bessa (2008), Heidloff (2013) and Prezi (2012) have confirmed that, with the feeling of pain and a limited ROM, no better performance in sports could be achieved. As an example, Heidloff (2013) stated that a high jumper with restricted ROM within the vertebral column, the hips or



knee joints will not be able to perform the flop style in high jump and most of the gymnastics activities.

Range of motion or flexibility is also very important in the prevention of most sports injuries which may graduate to the chronic stage due to lack of effective therapeutic care. Chronic sports injuries have ended the careers of many sports performers, therefore, acute injuries should be well treated (Bell, 2008; Jeon et al., 2015).

Youth sports in Central Region, especially at the SHS level are very vibrant and promising. Records at the office of the Central Regional Physical Education Coordinator indicates that for the past decade Central Region has always been ranked as either the first or the second during inter-regional schools and colleges sports festivals. However, SHS athletes of the Central Region are not left out from the destructive effects of sports injuries.

Records of the Region's medical team have revealed that averages of forty (40) injuries were managed during annual schools and colleges zonal athletics championships. Averages of forty five (45) injuries were also recorded during the annual super-zonal athletics championships (Central Region Schools and Colleges Federation Medical Team, 2016). In their report an increasing trend of injuries was noticed during these competitions. Such an increasing trend according to literature, is mostly due to fatigue and lack of effective therapies for their management (Korkmaz et al., 2014; Mock et al., 1999; Prezi, 2012; Polinder et al., 2016).

For years ice has been used as a very effective therapeutic modality in the management of acute pains and inflammation of the mentioned injuries (Grisogono, 2009; Young 2017). Though effective, literature and experience have revealed some limitations with the use of ice.

Ice therapy could lead to increase heart rate and breathing rate, constriction of blood vessels, joint stiffness, decreases capillary permeability and elasticity of soft tissues, impairment of reflex activities and motor functions (Beckerman, 2014; Carroll, 2015; Stoppler, 2015).

Thermotherapy is also used to manage acute sports injuries with some level of success, however, it is not recommended for the management of acute injuries because of its ability to increase blood flow, tissue metabolism, inflammation and edema (Petrofsky, Berk, & Lee, 2013; Scott, Weingand & Kruse, 2004).

Endorphin release therapy has been used by some physical therapists to manage sports injuries among student athletes during schools and colleges sports festivals in Cape Coast successfully (Central Region Schools and Colleges Sports Federation Medical Team, 2016). There is however no existing scientific research backing the effectiveness of ERT as a means of managing sports injuries. No proper documentation or research work has also been done to prove scientifically the effectiveness of ERT as a therapeutic modality.

The lack of scientific evidence on the effectiveness of ERT in the management of sports injuries is considered by the researcher as knowledge gap in extant literature. The current study was therefore conducted to fill the gap in the area of ERT usage as a means of effective management of sports injuries.

### **Purpose of the Study**

The study sought to ascertain the effect of ERT on musculo-skeletal pain and ROM among injured SHS athletes in the Central Region of Ghana.

### **Research Questions**

1. What is the effect of ERT on pain as experienced by injured SHS athletes of Central Region?
2. What is the effect of ERT on ROM as experienced by injured SHS athletes of Central Region?
3. How effective is ERT in the management of pain as experienced by injured SHS athletes of Central Region?
4. How effective is ERT in the improvement of ROM as experienced by SHS athletes of Central Region?

### **Hypotheses**

1. There will be no significant difference in pain level after ERT is used to manage injuries of SHS athletes of Central Region.
2. There will be no significant difference in ROM at the joint after ERT is used to manage injuries of SHS athletes of Central Region.
3. There will be no significant difference in the degree of pain reduction due to age, gender, years of participation in active sports, number of previous injuries and part of body injured.

### **Significance of the Study**

The findings of the study will provide knowledge on the use of ERT and add up to the existing literature on the management of pain and to improvement of ROM. The study will also reveal the therapeutic value of ERT which will become an empirical evidence for its use as an effective option for hospitals, clinics, physiotherapist, masseurs, team physicians, athletic trainers and first-aiders to use for the management of pain and to improve ROM of injured athletes. Finally, the findings could indirectly limit the use of orthodox drug which may have side effects on athletes.

### **Delimitation**

The study was delimited to pre-test post-test design, non-probability purposive and convenient sampling technique. An orthopedic mobility scanner, a standard goniometer and ERT were employed to collect data. The study also considered musculo-skeletal injuries (lower and upper limbs) of SHS athletes who were selected to represent Central Region during the 2017 Schools and Colleges Sports festival held in Central Region, Ghana.

### **Limitations**

Most of the regional teams came along with First Aider and sports therapists. They discouraged athletes, apart from those from Central region, from presenting themselves for ERT. Most athletes did not also have the needed rest because just after the intervention, coaches were on them to try and get back to active competition. There were some few cases of difficulty in placing the goniometer properly on the injured and swollen joint to be measured. In such

cases three (3) measurements were taken. The averages of the three measurements were considered as the right measurement.

### **Definition of Terms**

**Athletes:** All participants of team sports (games) and athletics.

**Etiology:** The study of causes of diseases.

**GUSA Games:** An acronym for Ghana University Sports Association Games.

**Hypertonic:** This refers to a situation whereby the concentration of solutes is greater outside a cell than inside it.

**Neural Plasticity:** Ability of the brain to change throughout the life of an individual in response to new situations and changing environment.

**Orthopedic Mobility Scanner:** An instrument used to measure the range of motion of the neck.

**Participants:** The injured SHS athletes from Central Region who agreed to be treated with ERT.

**Physical Therapy:** The management of physical disability, injuries and many others by the use of physical methods such as massage, manipulation of pressure points, bending and twisting of injured joints, etc.

**Range of Motion:** The range through which a joint can be moved, usually measured in degrees.

**SHS athletes:** SHS is an acronym for Senior High School. Therefore the term “SHS athletes” refers to athletes in Senior High Schools in Ghana.

**Standard goniometer:** An instrument used mostly by physiotherapist for assessing active extremity joint range of motion.

**Traumatic pain:** A stressful localized pain resulting out of an injury caused by an external physical force.

**WAUG:** An acronym for West African University Games

### **Organisation of the Study**

The study is organized under five (5) chapters. Chapter one gives an introductory background of the study, the problem statement, purpose of study, research questions and hypotheses, significance of the study, delimitation, limitations and definition of terms. Chapter two presented a conceptual framework and discussed comprehensively related studies on pain, theories of pain (Intensity, Specificity, Pattern and Gate control theories of pain), range of motion (ROM), the nervous system, pressure points, healing power of touch, common sports injuries and effects of age, gender and years of participation in active sports, number of previous injuries, and part of body injured on recovery from Injuries. The research design used, population, sampling procedures, data collection instruments with their validity and reliability indices, data collection procedures, and how data were processed and analyzed were all captured under chapter three. As chapter four highlighted the results of the study and discussion, chapter five presented the summary, conclusions, recommendations as well as suggestions for further research.

## CHAPTER TWO

### REVIEW OF RELATED LITERATURE

The purpose of the study is to find out the effect of ERT on pain and ROM of injured SHS athletes in Central Region of Ghana. This chapter is to discuss comprehensively related studies which will provide a theoretical framework to establish the usefulness of the study, as well as providing a benchmark for comparing the results with other findings (Gooch, 2002). The concepts and theories in the literature review were selected based on their expected relationship, and relevance to the achievement of the aim of the study

The following sub-headings were focused on during the review of literature:-

- i. Conceptual Framework
- ii. Definition of Pain
- iii. Acute Pain
- iv. Chronic Pain
- v. Theories of Pain
  - a. Intensity theory of pain
  - b. Specificity theory of pain
  - c. Pattern theory of pain
  - d. Gate control theory of pain
- vi. Measurement of Pain
- vii. Range of Motion (ROM)
- viii. Improvement of ROM
- ix. Measurement of ROM

- x. The Nervous System
- xi. Pressure Points
- xii. Healing Power of Touch
- xiii. Common Sports Injuries
- xiv. Effects of Age, Gender and Years of Participation in Active Sports, Number of Previous Injuries, and Part of Body Injured on Recovery from Injuries

### Conceptual Framework

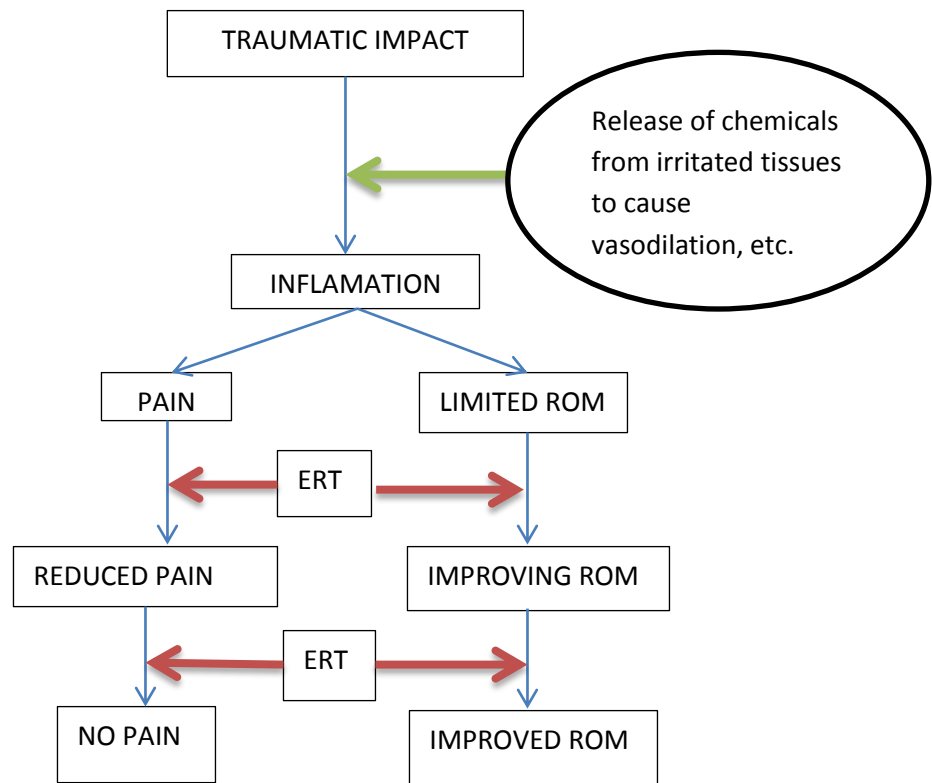


Figure. 1:- Conceptual framework of effectiveness of ERT on pain and ROM.



For the achievement of the purpose of the study, which is the filling of a knowledge gap, a conceptual theory was developed to underpin the study with a theoretical perspective (Bull, 2005). A conceptual framework, also referred to as content map, was also considered because it demonstrates the expected relationships between items within the domain being studied (Merlin, 2014).

The conceptual framework (fig.1) presented encompasses contemporary knowledge and attributes of traumatic impact, inflammation, pain, ROM, and ERT incorporated in the works of many theorists like Wilhelm Erb, Bernard Naunyn, Von Frey, Arthur Goldscheider, William Gowers, Roland Melzack and Charles Walls. Literature on sports injuries has revealed that most sports injuries start with a traumatic impact (Bradford, 2017). The impact of external force (contact with other players and equipment, etc.) on the tissues of the body leads to the damage of tissues involved. As a protective process, the irritation of damaged tissues elicit the release of chemicals like leukotriene, prostaglandins and others to cause many physiological changes including nerve stimulation and vasodilation. Increased blood flow to the areas of injury and leakage of fluid into the irritated tissues results into inflammation (Bull, 2005). Though a defense mechanism, inflammation primarily causes pain because the swollen tissues push against the sensitive nerve endings to send pain signals to the brain (Nordqvist, 2017). Inflammation has also been identified as the largest cause of ROM limitations. As a means to begin the repair of damaged tissues, the body sends many cells to the damaged area through the blood and lymph. The injured soft tissues become hypertonic, get swollen and tighten up the area to protect the

injured joint. The swollen soft tissues, which are the supporting structures, become weaker and shortened to limit ROM, and to cause pain in the injured joint (Jensen, 2011). The administration of ERT as an intervention, intermittently for some minutes, leads to the release of endorphins (Carry, 2006; Davis, 2011; Dobson, 2006) which helps to reduce pain gradually till the pain is relieved (Carty, 2006; Davis, 2011; Dobson, 2006; Fitzakerley, 2014; Huffington, 2014). Inflamed soft tissues also start reducing gradually along with the pain reduction to improve ROM (Fitzakerley, 2014; Gala, 2004; Huffington, 2014; Narins, 2014; Yazici, Pincus, Kautianen & Solka, 2004)

The major supposition emphasized in this conceptual framework is that, there is an underlying established knowledge base affirming the possibility of the genuine management of pain and limited ROM using ERT.

### **Definition of Pain**

The origin of the word pain could be traced from the Latin word “poena” and the Greek word “poine” all meaning pain or penalty. The French word “peine” could also be mentioned as an origin (Bio, Sabhra, Jackson, & Burge, 2007; Dictionary.com, 2002). Pain is defined by Bonica (2007) as an unpleasant sensation that can range from mild, localized discomfort to agony. Pain is also defined as a physical suffering or distress as due to injure or illness (Wlassoff, 2014). Apart from the above definitions, pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms such as damage (International Association of the Study of Pain, 2014; Medicinenet, 2016). The above definition goes well with

Melzack's conclusion that pain is a multidimensional complex with numerous sensory, affective, cognitive, and evaluative components (University of Calgary, 2015). Pain is considered by some authorities as a personal and abstract experience; it is purely subjective and cannot be communicated to another person. According to Cleveland Clinic (2014) and Ratini (2016) pain occurs when something hurts, causing an unpleasant condition of which the individual involved is the best judge. The agony associated with pain lets people see pain as a sinister invader of the body that must be expelled, hence the use of numerous painkillers of all sort. This approach has a crucial and dangerous flaw. Silencing pain without considering its message is like disconnecting a ringing fire alarm to avoid receiving and signaling bad news (Brand & Yancey, 1994). According to Brand et al. (1994), pain is not an invading enemy, but a loyal messenger dispatched by the body to alert you to some danger. To them pain is an essential priceless gift that nobody can live well without because it is protective insofar as it signals that the body is being threatened by an injury. Two common types of pain identified and recognised are acute pain and chronic pain (Spine Health, 2017; Guo, Wang, Sun & Wang, 2016; International Association of the Study of Pain, 2014; Wuhrman & Cooney, 2011).

### **Acute Pain Treatment Methods**

An acute pain is a sharp, immediate pain which comes from an injury of soft tissue but can also be triggered by bodily malfunction or severe illness. It is also defined as a type of pain that typically lasts less than 3 to 6 months (Spine Health, 2017; American Chiropractic Association, 2016).

A brief duration of pain or immediate pain triggered by injury or sudden illness can also be used as a definition to acute pain ( HealthGrades, 2015). According to Wuhrman &Cooney (2011) acute pain is “the normal, predicted physiologic response to an adverse chemical, thermal, or mechanical stimulus associated with surgery, trauma, or acute illness”.

Apart from the above definitions, acute pain is considered to be that pain that comes on quickly, can be severe, but lasts a relatively shorter period of time (MedicineNet, 2016). On the other hand Cleveland Clinic (2014) has made it clear that acute pain can be mild and last just for some few minutes. The pain goes away whenever the underlying cause of the pain is eliminated. However, untreated acute pain may lead to chronic pain.

Duarte (1997), cited by Post-Graduate Pain Management Team (PGPMT), Cardiff University (2012), defined acute pain as “pain temporarily related to injury and that resolves during the appropriate healing period. It often responds to treatment with analgesic medications and treatment of the precipitating cause. Acute pain is usually nociceptive, but neuropathic with the following characteristics:-

- a. Short durational- less than 3 months.
- b. Varying pain intensity (severe then to mild as healing takes place).
- c. Nervous system usually intact.
- d. Cause of pain can be identified (traumatic, surgery, among others.).
- e. Responds well to conventional analgesic.
- f. Pain reduces as healing takes place (PGPMT, Cardiff University, 2012).

From the above discussion, it is clear that acute pain was once defined simply in terms of duration. It is now viewed as a complex and an unpleasant experience with emotional and cognitive, as well as sensory features that occur in response to tissue trauma (University of Calgary, 2015).

Acute pain serves an important biological function, as it warns of the potential for an injury, and indicates the magnitude of an injury. A host of protective reflexes, for example, withdrawal of a hammered finger, muscle spasm and autonomic responses, often accompany it. However, the “stress hormone response” prompted by acute injury can also have adverse physiological and emotional effects (Guo, Wang, Sun & Wang, 2016; Hoffman, 2014; MedicineNet, 2016). Even brief intervals of painful stimulation can induce suffering, neuronal remodeling, and associated behaviours like bracing, abnormal postures, excessive reclining which may further contribute to the development of chronic pain. It is also possible for acute pain to activate the sympathetic branch of the autonomic nervous system to produce such responses as hypertension, shallow respiration, restlessness, pupil dilation and others (Wuhrman et al., 2011). Therefore, aggressive attention should be focused on the prevention and treatment of acute pain to reduce complications including progression to chronic pain states, extended hospital stay, readmission and patient dissatisfaction (Cleveland Clinic, 2014; Wuhrman, et al., 2011). The management of acute pain is comparatively simpler. According to literature, pharmacologic management has been known to be the corner stone of acute pain management (Post-Graduate Pain Management Team of Cardiff University, 2012; Webmd, 2016). Despite the

influence of multiple factors such as pain intensity, quality and pattern, patients preferences and drug side effect profiles in the selection of medications, most mild somatic acute pain are managed with oral non-opioids such as acetaminophen, non-steroidal anti-inflammatory drugs (NSAIDS), topical agents (e.g., local anaesthetics), and physical modalities of which rest, ice, compression and elevation are the well-known. In the case of moderate to severe acute pain, potent opioids are usually prescribed for treatment. It is sad to note that excessive concern about addiction and regulatory scrutiny are the main contributors to ineffective treatment of pain in general. The use of the non-pharmacologic approach involving the application of heat or cold, electro analgesia and relaxation as a supplement, is potent in maximizing pain relief and minimizing the risk of side effects (Lava, 2016; Narins, 2014; National Pharmaceutical Council {NPC}, 2015).

### **Chronic Pain Treatment Methods**

Chronic pain, also considered as a persistent and debilitating pain, was once defined simply as any pain that last longer than six (6) months beyond onset or beyond the expected period of healing (Cleveland Clinic, 2014; MedicineNet, 2016; Spine-health, 2017). However, new definitions differentiate chronic pain from acute pain based on more than just time .Chronic pain is now recognized as pain that extends beyond the period of healing, with levels of identified pathology that often are low and insufficient to explain the presence and/or extent of the pain ( American Chronic Pain Association, 2016; eMedicineHealth, 2017). Chronic pain is also defined as a persistent pain that disrupts sleep and

normal living, ceases to serve a protective function, and instead degrades health and functional capability (MaCaffery & Beebe, 1989). Thus, unlike acute pain, chronic pain serves no adaptive purpose. Chronic pain may be nociceptive, neuropathic or both, and caused by injury (for example, trauma, surgery), malignant conditions, or a variety of chronic non-life-threatening conditions (e.g. arthritis, fibromyalgia, and neuropathy). In some cases, chronic pain exists with no apparent cause. Although injury often initiates chronic pain, factors pathogenically and physically remote from its cause may perpetuate it (Bonica, 2007; Fitzakerley, 2014; International Association for the Study of Pain, 2014). Environmental and affective factors can also exacerbate and perpetuate chronic pain, leading to disability and maladaptive behavior (Board of Regents of University of Wisconsin System, 2010; Cleveland Clinic, 2014; Coan, 2006). Chronic pain such as that of a bad back or diseases of the nerves themselves, takes a more circuitous route. Pain signals enter the dorsal horn of the spinal cord and transfer back and forth between interconnected nerves that modulate the pain message as it travels up the spinal cord to the cerebral cortex, which assesses the damage and adjusts emotions and other bodily functions, such as breathing. This slower pathway creates duller, more persistent pain. If the pain persists, the entire nervous system may be reprogrammed to create a lower threshold for pain (Bigos, Bower, & Braen, 2010; Chung, 2017; Johnson, 2017).

Chronic and acute pains can be differentiated not only by time factor, but other factors as well. Whereas acute pain serves as a protective warning signal, chronic pain has no known survival benefit (Cleveland Clinic, 2014). Evidence

suggests that generation and subsequent maintenance of chronic pain, as opposed to acute pain, may involve changes in central pain processing mediated through mechanisms of neural plasticity and ultimately leading to hyper-excitability of central structures in the spinal cord and brain. To complicate matters, unremitting pain may be associated with depression and/or anxiety. As a practical matter, it is noted that the distinction between acute and chronic pain is somewhat arbitrary and chronicity may be reached from one to six months post injury (Guo et al., 2016). However, Guo et al. (2016) recognize that the most clinically useful definition of chronic pain might be “pain persisting beyond the usual course of healing of an acute disease or beyond a reasonable time for an injury to heal”. The intensity of chronic pain may range from mild to severe due to the underlying long-term medical condition such as arthritis, back pain, cancer and headaches (Bonica, 2007).

According to Bigos et al. (2010), chronic pain can also be present without apparent physical cause or identifiable etiology. They however described chronic pain as a unique and complex phenomenon that may persist despite the intervention of medical treatment and the passage of time. Literature has made it clear that chronic pain also causes similar physical, psychological and social burden such as those seen in chronic illnesses (WebMD, 2016). It is also of interest to know that, the combined effects of the physical, psychological and social characteristics of chronic pain contribute to bring about the persistence of pain (NPC, 2015). As a result a comprehensive approach including medication and functional rehabilitation to help address all the contributing factors is



required for the management of chronic pain (eMedicine, 2017). For effective functional rehabilitation, composite factors like patient education, regular assessment and management of contributing illnesses (for example, depression), and the setting of attainable treatment goals are vital to help patients develop skills only to manage, but not to treat the persistent pain (NPC, 2015). Consequently, chronic pain patients may suffer pain for the rest of their lives. In such a situation, the management of chronic pain will basically focus on reducing the impact of pain on patients' lives and helping them cope with pain (Cleveland Clinic, 2014). The NPC (2015) has made it clear that, the general treatment goals of chronic non-cancer pain (CNCP) should therefore include the following:-

1. Diminishing physical and emotional suffering
2. Increasing or restoring physical, social, vocational and recreational function
3. Optimizing health, including psychological well-being
4. Improving coping ability (such as developing self-help strategies, reduce dependence on health care system) and relationships with family, friends, health care professionals among others.

Contemporary medicine is however trying hard to end the suffering of chronic pain sufferers in general by developing more treatment options. The Radiofrequency Ablation (RFA) is one of the modern treatment options which can relieve pain for 8 months to a year. The RFA as a therapy basically aims at the nerves that send pain impulses to the brain. In the process the doctor places a needle with a tip that heats up very close to the nerve sending pain signal to the

brain. The heat will zap the nerve preventing the sending of any pain signal to the brain. Literature has revealed that, the treatment has helped in many cases including arthritis, neuropathy, lower back, hip, knee and neck pain. Anita Gupta, co-chair of the American Society of Anesthesiologists Ad Hoc Committee for Prescription Opioid Abuse, has been cited to have revealed that research is in progress to release a more effective version called “cooled RFA” (Rushlow, 2017). The Pain Shots, a type of treatment which delivers medicine, usually a combination of steroids and local anesthetics, directly to where they are needed are also used by doctors to help chronic pain patients. The local anesthetics is supposed to numb the nerve or muscle, while the steroids ease inflammation to lower the pain. Some of these Pain Shots are Nerve root blocks, Epidural steroid injections and Trigger point injections (Ratini, 2016).

The Nerve root blocks aim at nerves along the spine which cause pain in the arms and legs while the Epidural steroid injection is used to help patients suffering from disc problems like herniated discs. Muscular tight spots may also squeeze nerves to cause pain. With such tight muscular problems the trigger point injections are found to be effective. Pain shots are not the ultimate but can last from 4 weeks to a year. For a longer duration of pain relief, a device known as pain pump, may be implanted near the spine to release a slow drip of medication automatically to manage pain (Rushlow, 2017).

Another known technique of managing pain is prolotherapy. It is a non-surgical medical treatment where a natural irritant is injected into the soft tissue of an injured or inflamed joint to stimulate healing. Once activated with the

injection of a potential irritant, such as a sarapin or saline solution, the body starts to strengthen and repair damaged ligaments in the joint. Over time, the strengthening of the soft tissues of the joint helps to stabilize the joint. The benefits of prolotherapy are that, the treatment is permanent and natural. It relies on the body to repair itself to reduce pain of the injury reduces as the ligament strengthens. Though effective, the use of prolotherapy is limited because it requires about 4 to 15 shots per session for about 3 to 6 months. This may result in temporary pain or swelling at the place of injection. Another side effect is that, immediately after the procedure, the pain felt in the affected joint may be worse before beginning to feel better. A high level of skill is also required to inject precisely specific areas requiring the reconstruction of the damaged ligament. A thorough assessment is also carried out by the use of X-ray and other imaging results to ascertain if the patient is a good candidate since the therapy is not good for chronic cases. A suitable candidate is also advised to eat well, especially a protein-rich meal on the day of the therapy (Fletcher, 2017).

The prescription of more powerful painkillers like morphine, fentanyl, hydrocodone (vicodin), methadone and oxycodone (oxycontin) are not the priority of most doctors, even though very effective. They have side effects that can lead to drowsiness, nausea, vomiting, confusion, dizziness, constipation, addiction and accidental overdose (Ratini, 2016).

Massaging in quiet environment assists pain, tension and stress to seep from tight to relax. In this light, meditation and deep breathing comes to mind as effective relaxation techniques to relieve stress, pain and tension. Reduction of

stress in one's life by listening to soothing and calm music is also recommended since the potentials of depression (anxiety, stress and anger) to increase the body's sensitivity to pain could be suppressed (Lava, 2016; Lidell, 2007). Chronic pain patients (CPP) are also advised to engage in active exercise for the released natural endorphins to boost the relief of pain. Apart from the release of endorphins, exercise also strengthens muscles thereby helping to prevent re-injury and further pain (Hoffman, 2014). Joining social support groups is another option where CPP may benefit from the wisdom of pain coping strategies and interesting hobbies used by other patients. Hoffman (2014) has advised against the taking in of alcohol as a pain coping strategy since it can worsen sleeping problems to cause more pain.

Deducing from the fact that stiffness produces pain, and is a protective mechanism of the CNS, Hargrove (2008) concluded that, the fastest and most powerful way to reduce pain and increase performance is simply to lower your body's protective mechanisms in regard to movements and posture.

### **Theories of Pain**

Pain has existed as a natural phenomenon experienced in different ways and forms since creation. It should therefore not be a surprise to read about several theories proposed several centuries ago to explain the physiological basis of pain and mechanisms underlying pain perception, although these theories have not yet completely accounted for all aspects of pain perception (Perl, 2007). The four most influential theories of pain that would be considered by this study

review include the Intensity Theory, Specificity Theory, Pattern Theory, and Gate Control Theory of pain.

### **Intensity theory of pain**

The Intensity theory which was formally known as the Intensive or summation theory has a great history and was first conceptualized in the fourth century BCE by Plato in his oeuvre *Timaeus* (Physiopedia, 2015). According to the theory, pain is not as a unique sensory experience but rather, an emotion that occurs when a stimulus is stronger than usual.

Literature has indicated that Plato's theory was based on Aristotle's concept that pain resulted from excessive stimulation of the sense of touch. Wilhelm Erb has been branded with the Intensity theory because he conceptualized that pain can occur in any sensory system when sufficient intensity was reached rather than being a stimulus modality in its own right (Basbaum, 2011).

Literature has also indicated that experiments performed by Bernhard Naunyn in 1859 revealed that repeated tactile stimulation (below the threshold for tactile perception) produced pain in patients with syphilis who had degenerating dorsal columns. When the same stimulus was presented to patients 60–600 times, they rapidly developed what they described as unbearable pain. After series of experiments with different types of stimuli, including electrical stimuli, Naunyn concluded that there must be some form of summation that occurs for the sub-threshold stimuli to become unbearably painful.

Based on Naunyn's conclusion, it is reported that Arthur Goldscheider further advanced the Intensity theory by suggesting a neurophysiological model

to describe this summation effect: repeated sub-threshold stimulation or supra-threshold hyper-intensive stimulation could cause pain. He suggested further that the increased sensory input would converge and summate in the gray matter of the spinal cord. This theory competed with the Specificity Theory of Pain, which was championed by von Frey. According to literature the theory lost support with Sherrington's evolutionary framework for the Specificity theory which postulated the existence of sensory receptors that are specialized to respond to noxious stimuli, for which he coined the term “nociceptor”( Physiopedia,2015).

### **Specificity theory of pain**

Among the first modern theories of pain is the Specificity theory of pain propounded by Von Frey in 1895. This theory talks about the presence of specific dedicated pathways for each somatosensory modality. The fundamental tenet of the Specificity theory is that each modality has a specific pain receptor and associated sensory fiber (primary afferent) that is sensitive to one specific stimulus (Dubner, Sessle, & Storey, 1978). In simple terms the theory is of the view that there are specific pain receptors which are responsible to transmit pain signals to a “pain center” in the brain to produce the perception of pain.

According to literature, Frey argued that the body has a separate sensory system for perceiving pain just as it does for vision and hearing. In the same order, noxious stimuli would activate noxious receptors (nociceptors), which would project to higher “pain” centers through a pain fiber, just as a non-noxious stimuli would be signaled and received by non-noxious receptors for interpretation (Findlater, 2016).

The discovery of specific, cutaneous touch receptors, such as Pacinian corpuscles, Meissner's corpuscles, Merkel's discs and Ruffini's end-organs in the latter one-half of the 19th century, provided further evidence that specific sensory qualia were encoded by dedicated nerve fibers (Findlater, 2016 ).

Further evidence for the Specificity theory came out after series of experiments conducted by Schiff and Woroschiloff's who revealed a pain pathway in the spinal cord after incisions at different levels of the spinal cord: the anterolateral pathway for pain and temperature, and the posterior bundles for tactile sensibility. Amazingly, the findings above were supported by a case study by William Richard Gowers, a physician in London, who reported that a patient with a bullet wound to the gray matter of the spinal cord lost the sense of pain and temperature but not touch. He therefore concluded that there were specific pathways for pain and temperature, separate from that of touch (Rey, 1995).

The Specificity theory, though was able to appropriately described sensory receptors that are specific to nociceptive stimuli and primary afferents that show responses only to suprathreshold stimuli, it failed to throw light on neurons such as the wide-dynamic range neurons that respond to both non-nociceptive and nociceptive stimuli in respect to pain perception.

The theory does not also explain for the numerous psychological factors that affect perception of pain. For example, the theory cannot explain why a warrior will report little or no pain on a serious weapon injury he suffered from a war. Such weaknesses might be the motivating factors for another school of thought to propound the Pattern theory of pain (Physiopedia, 2015).

### **Pattern theory of pain**

Nafe, Melzack and Wall could be mentioned as leaders of the school of thought who ignored findings of specialized nerve endings and many of the observations supporting the Specificity and Intensive theories of pain for the Pattern theory. According to them, afferent fibres respond to a host of stimulus modalities which are transmitted to the brain to read, process and interpret the different patterns of activity across the different nerve fibres for the ultimate perception (University of Calgary, 2015). In simple terms, the theory assumes that pain impulses are sent to the brain only when a pattern could be produced from the summed up stimuli.

In support of the pattern theory, Basbaum (2011), has made it clear that “it is certainly possible that convergence of “specific” inputs at the level of the spinal cord or higher in the neuraxis generates an integrated pattern of activity that is read by the brain, the product of which is the ultimate percept”.

Despite the fact that the Pattern theory did not consider the role of specific specialized receptors for pain perception nor the brain having control over pain perception, but rather a message receiver, it was able to prepare the grounds for the Gate Control theory (American Physiological Society, 2016; University of Calgary, 2015).

### **Gate control theory of pain**

As a means to revolutionize research on pain, Ronald Melzack and Charles Patrick Wall proposed the Gate control theory (GCT) of Pain in 1965. According to literature, the GCT did not reject earlier experimental evidence which



supported both the Specificity and Pattern theories but came up with a model which could explain and bridge the gap between the seemingly opposing theories (Deardorff, 2015).

Among the assumptions made by the theory is that signals produced in primary afferents from stimulation of the skin were transmitted to two main regions within the spinal cord: the substantia gelatinosa (SG), and the first central transmission cells (T). The (SG) in the dorsal horn, which modulates the transmission of sensory information from the primary afferent neurons, is the neurological gate containing inhibitory interneurons (Physiopedia, 2015).

Apart from the above assumption of the GCT is the existence of nerve fibres which carry signals or sensations from sensory organs to the brain through the spinothalamic tract. These nerve fibres could be classified into three types: A, B and C fibres according to their axonal diameter and conduction velocity. The smallest among the three is the C fibres.

Unlike the B and C fibres, the A fibres are of four types being the A- alpha, A- beta, A- gamma and A- delta. The A- alpha fibres are known to be the largest while the A- delta, the smallest. The small fibres are two, namely the A delta ( $A\delta$ ) and C fibre. The  $A\delta$  fibre is myelinated, faster and transmits sharp prickly pain. On the other hand, the C fibre is unmyelinated, slower and transmits dull aching pain. It is interesting to note that, the A- beta ( $A\beta$ ) fibre is also myelinated but transmits non-painful stimuli like rubbing, touch, pressure, temperature and vibration used in massaging, ERT and other physical therapies (Moayed & Davis, 2013).

According to the theory, the gating mechanism is controlled by the activity in the large-fibre and small-fibre. More large-fibre or only large-fibre stimulation activates the inhibitory neuron; closing the gate to prevent the projection neuron (transmission cells) to fire pain impulses to the brain. On the other hand, more (intensity) small-fibre or only small-fibre activation (pain) leads to the release of glutamate ( a neurotransmitter) by the small-fibre to cause both excitation of the projection neuron and inactivates the inhibitory neuron; opening the gate to allow the projection neuron to fire pain impulses upward to the brain via the spinothalamic tract (Deardorff, 2015). When there is no external stimulation to activate small fibres, the inhibitory interneuron naturally activates to inhibit the projection neuron to send nociceptive signals to the brain (Freudenrich, 2017).

It could be realized from the above explanation that various factors, including the intensity of the pain signals, the intensity of the other sensory signals (pressure, rubbing, temperature, touch and vibration) generated at the site of injury and influence of descending signals from the brain determines how pain signals should be treated at the neural gates (Wlassoff, 2014).

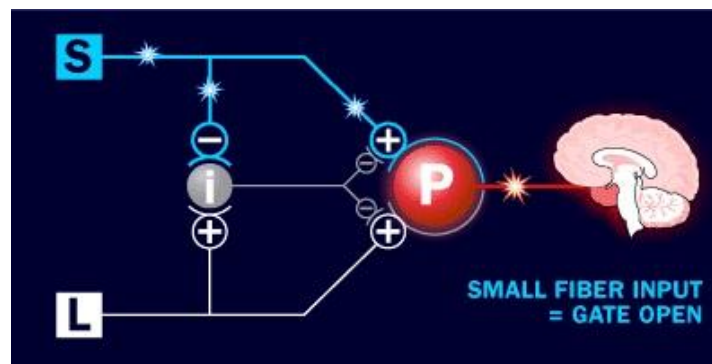


Figure 2:- Opened gate from Craig Freudenrich. *How pain works*, 2007; [www.science.howstuffworks.com/life/inside-the-mind/](http://www.science.howstuffworks.com/life/inside-the-mind/); June 20, 2017

The neural circuit diagram, figure 2, is illustrating small-fibre stimulation inactivating the inhibitory neuron:- “i”, opening the gate to allow transmitted pain signals:- red line with \* from the projection neuron:- “P”, to reach the brain. The light-blue and white horse shoe shaped line around “P” is the opened gate.

The light blue coloured structure (S) with three stars (\*) forming the top part of the diagram represents the activated small-fibre (nociceptor). The white coloured structure (L) below is the non-stimulated large-fibre (non-nociceptors).

Figure 3 is illustrating a “closed gate” situation where a relatively stronger activity of the large fibre excites the inhibitory interneuron to fire. The firing of the inhibitory interneuron closes the gate, preventing the firing of the projection neuron (transmission cells), even in the presence of a firing nociceptive fibre (+ end of S) from reaching the brain.

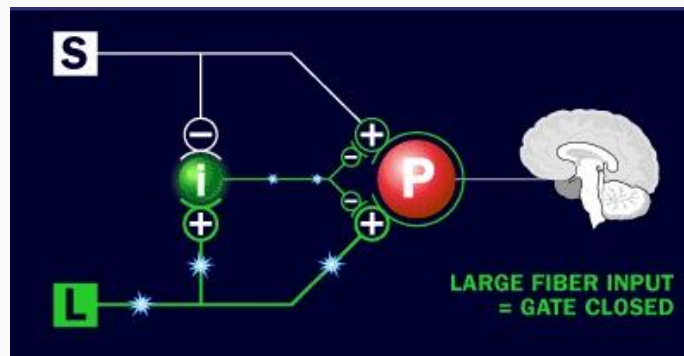


Figure 3:- Closed Gate from Craig Freudenrich. *How pain works*, 2007; [www.science.howstuffworks.com/life/inside-the-mind](http://www.science.howstuffworks.com/life/inside-the-mind); June 20, 2017

From figure 3 the small fibre “S” now coloured white, with no stars (\*), is not stimulated enough to fire (- end of S) to prevent the inhibitory neuron (i) from firing. On the other hand, “L” now coloured green, with three stars (\*), is strongly activated (two + ends) to excite inhibitory neuron (“i” with green

background) to fire to close the gate (green horse shoe structure around big red dot with “P”) to prevent fired pain impulses from “S” to reach the projection neuron thence to the brain.

Apart from the activities of the large- fibre and the small- fibre in controlling the gate, activities from descending fibres that originate in the supraspinal regions and project to the dorsal horn could also close the gate to reduce pain perception (Basbaum, 2011). This is to say that, in a descending order the central nervous system has the ability to block pain signals at the spinal cord level. As part of the endogenous analgesic system are brain stem neurons which release endogenous opioids like  $\beta$ - endorphins, enkephalins and dynorphins, collectively known as endorphins, to act on opioid receptors. Opioid receptors are located at the nerve endings of both primary afferent (sensory) nerve and the projector interneuron to block neurotransmission of pain signals (Biological Sciences, 2017; Carroll, 2016; Wlassoff, 2014).

From the above discussion, it is clear that the GCT of pain provided a neural basis for the findings that supported and helped to reconcile the apparent differences between the Pattern and Specificity theories of Pain and has helped in disassociating pain perception with the intensity of the pain stimulus and the degree of damage caused to the affected tissue. Melzack and Wall also made it evident that pain perception is far more complex because pain signal transmission can be influenced by emotions and thoughts. It is a fact that people do not feel their chronic pains whenever they concentrate on other interesting activities. The winning goal of a soccer championship match is able to propel all

injured players on the bench to jump up in celebration, forgetting their pains (Wlassoff, 2014).

Apart from the above merits, the GCT has been a solid backbone of the TENS (transcutaneous electrical nerve stimulation) therapy, and could be used as the scientific bases to explain how ERT, of which this study is about, works. TENS and ERT are all non-invasive and inexpensive pain management approaches used for chronic and acute traumatic injuries (Carty, 2006; Fitzakerley, 2014).

Despite the fact that the GCT has dramatically revolutionized the field of pain research and sown seeds for studies aimed at eliminating the burden of chronic pain patients, it has its own shortcomings.

According to literature there are indications that many of the details of the theory are inaccurate. The presentation of the neural architecture of the spinal cord, the location and the model pertaining to how large afferent fibre stimulation inhibits or modulates small-fibres were seen to be oversimplified with flaws (Nathan & Rudge, 1974), and the hypothesized modulatory system which we now know includes descending small-fibre projections from the brain stem (Treede, 2001). Another criticism against the theory is that it focuses on peripheral nerves and cutaneous pain and do not address issues pertaining to deep-tissue, visceral, or muscular pains. It will therefore not be possible to manage pain permanently with drugs or surgery (Mendell, 2013).

## Measurement of Pain

The measurement of pain, a symptom which is felt and measured by only by the patient, is very subjective. However, participants at the Outcome Measures in Rheumatology (OMERACT 11) meeting agreed for the use in clinical trials, the 5-point Likert scale and /or visual analog scale (VAS) to measure pain (Singh, 2014). A Likert scale is a psychometric scale named after its inventor, Rensis Likert. In responding to Likert questionnaire item, the subjects register their level of agreements or disagreements on a symmetric agree-disagree scale for a series of statement (McLeod, 2008).

The VAS is a means to measure subjective constructs believed to exist along a continuum. As a straight line VAS usually measures from “0 mm” up to “100mm” with extreme descriptors at either end. Attitude of interest could be measured by placing a point somewhere along the line to represent once subjective experience. The distance of the placed mark to the nearest extreme point is then measured in millilitres to arrive at an estimated intensity (Bushnik, 2011).

The 11- points Numerical Rating Scale (NRS) is another pain measuring instrument. Unlike the pictorial faces scale, paper and mechanical VAS, and others which will require both the therapist and patient to perform some task, NRS is simple, requires less cognitive energy and verbally administered without cost or possibility of infection to the subject (Jensen, Karoly & Braver, 1986; Kremer, Atkinson & Ignelzi, 1981; Pain Community Centre, 2014). The patient is asked to indicate verbally how much pain he or she feels. The response may

range from “0” if there is no pain and “10 if the pain is severely painful (Von Baeyer, Spagrud, & Choo, 2009). Chung, (2001), used the 11-point NRS to measure intensity of pain in his research work entitled, “Pain characteristics of and Pain Management Strategies used by Adults seeking Chiropractic Care”.

Pain scales, being interval in nature, are assessed in terms of concurrent validity, using another pain intensity measure as an external criterion, because of the lack of a standard pain measure (Bushnik, 2011).

### **Range of Motion**

The mention of range of motion (ROM) brings to mind the concept of flexibility and joint stiffness. Joint stiffness, according to Yazici, Pincus, Kautiainen and Solka (2004), is not a disease, but can be considered as either a symptom of pain on moving a joint, the symptom of loss of ROM or the physical sign of reduced ROM. From the above definition and experience, it could be said that most stiffness of joints associated with sports injuries like sprain and strain are signs of the unwillingness of a victim to move due to severe pain felt during the movement of the injured joint. This understanding may explain why flexibility or ROM improves as pain at the injured joint is relieved. Stiffness is also seen as a protective mechanism of the central nervous system (CNS). When the body is in pain, the CNS is alerted to stiffen muscles as a protective mechanism. A painful ankle causes a stiff calf, and a painful low back leads to uncoordinated hips and stiffness in the entire midsection of the body (MedicineNet, 2012). Fortunately, when we are under the effect of endorphins or anesthesia, this protective mechanism of stiffness is turned off, and flexibility

as well as ROM increases drastically (Hargrove, 2008). Flexibility and ROM are words commonly used interchangeably since they all refer to movement at a joint, and there is a very strong positive relationship between the two. Range of motion depends of flexibility directly. A full ROM at joint means flexibility at that joint is very good. On the other hand a limited or poor flexibility at a joint will lead to a limited ROM at the joint (Johnson, Kim, Yu, Saliba, Grindstaff, 2012; Villa-Forte, 2014). Flexibility is defined as “the ability to move joints effectively through a complete range of motion or the range of motion in a joint” and it is needed to enable a joint to have full range of motion (Scott, 2017).

Range of motion as a concept has attracted many similar definitions. Mooney (2009) defined ROM as “the natural amount of movement within a joint”. The Medical Dictionary for the Health Professions and Nursing (2012) has also defined ROM as the range measured in degrees of a circle, through which a joint can be extended and flexed. From another angle, McLaughlin (2010) sees ROM as a measurement of movement around a specific joint or body part. As a conclusion, the definition of Winsper (2016) which indicates that ROM is the full movement potential of a joint, usually its range of flexion and extension will be considered. Flexibility, which contributes to injury prevention, general health and better sports performance, is also important for a joint to have its full ROM. Increase flexibility has a positive relationship with full ROM and better athletic performance. A full joint ROM improves suppleness and contractility of surrounding muscles, as well as a decrease in wear and tear on the articular structures encapsulating the joint. Such a situation promotes healing of



stressed tissues which assist in motor-learning process to ensure more effective and correct performance techniques (Winsper, 2016). However, factors like pain, swelling, injuries, and side-effects of some diseases like arthritis, joint structure, fat tissues, body temperature, activity level, age and genetics affect joints negatively to cause joint stiffness which limits flexibility and ROM (Clark, Corn, & Lucett, 2008). Playing sports with limited ROM increases risk of injury and affects performance negatively. A limited dorsiflexion ROM can contribute to ankle sprain, Achilles tendinitis, knee injuries, plantar fasciitis and tight calf muscles (Boyd, 2016).

According to Cronin (2014), a restricted knee joint can cause wearing out of some parts of the knee joint to create a relatively short leg which can lead to future injuries to the knee, hip, ankle and the back. The stride length could also be decreased to cause imbalance to weaken quadriceps muscles to affect performance. The negative effect of limited ankle ROM on performance has also been noted. In sprint races, a limited ankle range of motion will not allow full flexion of foot to get all the power needed to push off from the starting blocks to improve reaction time for better race time. Restricted ankle ROM, also affects reaction for a missed rebound in basketball, and a missed pass in football (Boyd, 2016). Limited ROM has also been noted to be a contributor to poor posture and dysfunctions in the kinetic chain which can lead to cumulative injury cycle. The limited ROM leads to tissue trauma, thence to inflammation, muscle spasm, adhesions, altered neuromuscular control, muscle imbalance and back to tissue trauma to complete the cycle (Clark, Corn, & Lucett, 2008).

Another factor leading to limited ROM (joint stiffness) is the loss of functional ability by ruptured or torn ligaments which supports and promotes joint movement. The lack of functional ability normally brings about weakness of the joint. Such a weak joint, normally, cannot permit any better ROM. It should therefore not be a surprise when the stiffness of the joint or the ROM of the joint improves after the ruptured ligaments are healed (Sports Injury Clinic, 2014). The three main types of ROM are active ROM, active-assistive ROM and passive ROM (McLaughlin, 2010). Active ROM comes to play when the individual or client is able to move a joint through the full ROM independently. The coach or therapist involved may only provide verbal coaching points or verbal cues for the exercise to be done well. The stretching exercises performed by athletes during warm-ups are examples of active ROM.

The active-assistive ROM is the situation when the performer or client is manually assisted by the therapist or by the use of a strap/band to help in the performance of movement around a joint. Though progressive in nature, there is the feeling of muscle weakness and pain, therefore, the process should be performed gradually.

According to McLaughlin (2010), passive ROM is practiced when the joint is inactive. In this case the client does not perform any movement around an injured joint. It is the therapist who stretches the soft tissue of the client's injured joint to prevent stiffness. A paralyzed limb can be helped with passive-ROM. Passive ROM is highly recommended when it comes to goniometric assessment

because it has been shown to be the gold standard and reliable when performed by the same tester (Scher et al., 2010).

### **Improvement of ROM**

Lack of physical activities, ageing and injuries have been mentioned as common factors which limit ROM. Sedentary life styles do not allow the full movement of various joints and parts of the body. Muscles, connective tissues, tendons, ligaments and joints tend to tighten with sedentary attitudes making ROM and flexibility more restricted and making them more injury prone (Massage Envy Franchising, 2017).

Apart from stretching which is used mostly to maintain and improve restricted ROM, massage therapy could also be used as an effective therapeutic modality to maintain and improves ROM and flexibility because it is a natural way to relax stressed muscles, to prevent the building up of lactic acid in the blood, to stimulate blood flow, to reduce muscle soreness and to keep joints more fluid to prevent injury (Bell, 2008; Pandey; Nigam; Goyal, & Chabra, 2007).

### **Measurement of ROM**

The clinical measurement of ROM has been considered as a fundamental evaluation procedure with ubiquitous application in physical therapy. Objective measurement of ROM and correct interpretation of the measurement results can have a substantial impact on the development of the scientific basis of chosen therapeutic intervention.

The goniometer has been the most popular instrument used by physical therapist to measure ROM of the extremities despite other known methods

including the use of an inclinometer, simple visual estimation and the high-speed cinematography. Tape measures are also used to identify lumbar ROM if an inclinometer is not available (Shultz, Houghlum & Perrin, 2010; Engelbert, 2008). Historically, goniometry developed over the last 60 years in conjunction with the rapid growth in the field of physical therapy and rehabilitation. The universal goniometer has remained the most versatile and widely used instrument in clinical practice due to its simple measurement procedure, reliability and validity (Gajdosik & Bohannon, 2001).. Despite the errors in measurement of angles which may arise due to the instability of the hands of the therapist, a standard plastic goniometer is preferred as an instrument for measuring ROM due to low cost, simplicity, portability and reliability (Klein, 2007).

In a comparative study involving the use of a smartphone and a universal goniometer, the results revealed a reliability of 0.95 for both instruments in elbow supination and 0.84 in elbow flexion (Wolf, 2016). A study on the reliability of the universal goniometer for assessing active cervical ROM revealed excellent within-session and between-session inter-rater reliability of ICC = 0.83 to 0.98 and ICC = 0.79 to 0.97 respectively (Farooq, Bandpei, Ali & Khan, 2016). Clapper & Wolf (2012) have also reported an intra-examiner reliability Coefficient of  $r = .96$ . According to Shultz et al. (2010), the measurement of ROM accurately with the goniometer depends on precision, as a factor, which could be achieved only through practice and skillful observation. Apart from precision, they went further to mention the positioning and stabilization of the patient and the segment to be measured, the appropriate

determination of the end of ROM of the joint, identification and palpation of the correct landmarks of the limb, the placement of the goniometer at the proper position, and the reading of the measured angle correctly as very crucial factors to be considered.

### **The Nervous System and ERT**

By its structure and function, it is the nervous system which transmits, interprets and coordinates the numerous complex impulses required for existence and performance (Hoffman, 2014). It is also through the nervous system that most sports related injuries come to the attention of athletes, first-aiders, medical practitioners, athletic trainers, as well as physical therapist of all kinds, in the form of signs and symptoms (Mair, 2014). It is therefore imperative to have an appreciable knowledge about the nervous system to understand ERT as a scientific therapeutic modality.

As a biological system of the body, the nervous system consists of organs such as the brain, spinal cord, nerves . As a whole, the nervous system is divided in two sub-divisions; the central nervous system (CNS) and the peripheral nervous system (PNS). The brain and the spinal cord which are two important organs located in the central part of the body combine to form the CNS. The organs of the PNS are mainly the nerves which extend from the CNS to peripheral organs. The 12 pairs of cranial nerves which originate from the brain and the 31 pairs of spinal nerves (8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 coccygeal nerve) are examples of the PNS. They extend from the brain and the spinal cord to peripheral organs such as muscles and glands. The PNS is sub-

divided into sensory (afferent) nerves and motor (efferent) nerves due to their functions. The sensory nerves carry electrical impulses from receptors in sensory organs such as the skin, eyes, and others to the brain through the spinal cord; the CNS. On the other hand, motor nerves transmit electrical impulses from the CNS to the peripheral organs to cause an action.

Furthermore, the motor (efferent) wing of the PNS is sub-divided somatic nervous system and the visceral (autonomic) nervous system. The somatic nervous system transmits motor impulses which permit conscious control of the skeletal muscles, hence are sometimes called voluntary nervous system. The visceral (autonomic) nervous system, on the other hand, transmits motor impulses to cardiac muscles, smooth muscles, and to glandular epithelium. The impulses involved here cannot be controlled consciously, therefore, are called involuntary nervous system (Babalola, 2011).

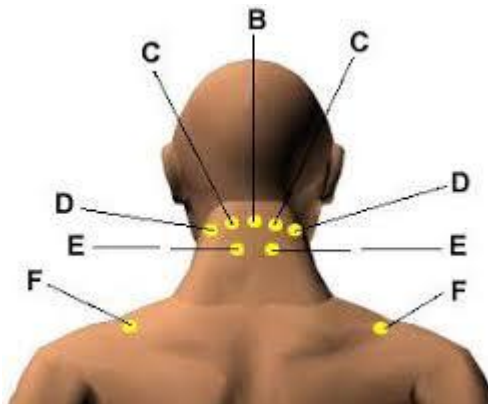
As the final sub-division, the visceral (autonomic) nervous system is divided into sympathetic and parasympathetic nerves. The sympathetic nerves are seen to be active during stress while the parasympathetic dominates during periods of physical rest and emotional calmness (Merriam-Webster, 2016). According to Lane (2012), the dynamic balance needed to exist between the sympathetic and parasympathetic nervous system is promoted by pressure points.

### **Pressure points and ERT**

Pressure points are specific sensitive points on the surface of the body which are exploited by the endorphin release therapist to remove roadblocks along the body's internal electro-magnetic energy channels or meridians

(Highland, 2017; Johnston, 2017). In response to a gently but firm pressure (touch) on a pressure point, the brain oozes endorphins that muffles pain signals and invites pleasurable feeling. In the absence of pain, muscles relax and blood flows more freely to promote holistic healing and wellbeing (Guthrie, 2014).

According to Mukherjere (2017) and Ryan (2016), stimulating pressure points relaxes muscular tension by releasing endorphins which provide long-term relief from ailments and pain, preventing the body from relying blindly on drugs. For the management of traumatic pains, pressure points of some parts of the body, as exhibited by figure 4, up to figure 12 have been prescribed by some experts.



*Figure 4:- Pressure points for neck pains from Bipasha Mukherjere. Acupressure treatment to heal 10 most common body pains. 2017; <https://www.modernreflexology.com>; May 25, 2017.*

Reference to figure 4, point **B** is located at the centre of the meeting point of the skull and the upper neck. Points **C** are located in the hollows underneath the base of the skull, about 3 to 4 inches apart, depending of the size of the neck of the individual. These points could be utilized to release shoulder pains, neck stiffness, and headaches (Gach, 2015). Points **D** are located a thumb width from

points **C** at the adjacent (distal) sides. Points **E** are on the back of the neck, one thumb width down from the base of the skull, and one thumb width out from the centre of the spine on both sides. Points **F** are on top of the shoulders, two finger widths out from the distal base of the neck.



*Figure 5:- Pressure point for hip pains, from Bipasha Mukherjee. Acupressure treatment to heal 10 most common body pains. 2017; <https://www.modernreflexology.com>; May 25, 2017.*

The point GB29 of figure 5 is located in the hip region, at the centre of the line connecting the great trochanter of the femur and the anterior iliac spine. It is also known as the Squatting Bone Hole (Mukherjee, 2017).

Other local pressure points for hip and waist pains are the GB30 (Gall Bladder 31) or “Jumping Round” point located in the gluteal muscles, between the sacrum and greater trochanter, the GB31 or the “Wind Market” point located on the sides of the thigh, midway between the hipbone and the knee, and the GB34 or the “Yang Mound” point situated at the Centre of the outer depression 3 thumbs-width below the knee (Mukherjee, 2017). It is also known as the



“Three Mile Point”. Pressure on this point also helps with the toning of muscles tone and strengthening of the body (Bushak, 2015).

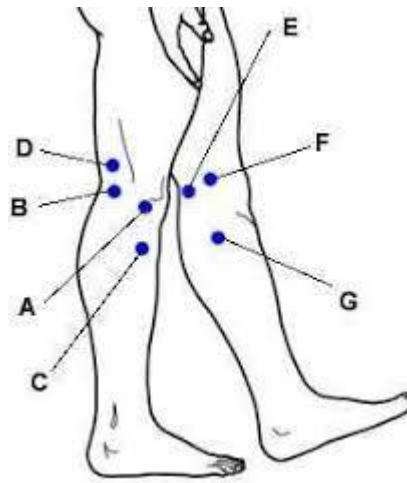
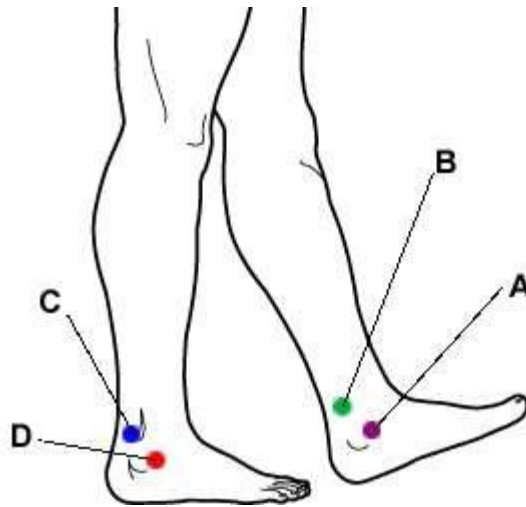


Figure 6:- Pressure points for knee pains, from Bipasha Mukherjere. *Acupressure treatment to heal 10 most common body pains*. 2017; <https://www.modernreflexology.com>; May 25, 2017.

The locations of the pressure points exhibited on fig.6 are indicated below.

- A. Outer side under the knee cap.
- B. Edge of the crease on a bent knee.
- C. Centre of outer depression 3 thumbs-width below the knee.
- D. Two thumb-widths above the intersection of the horizontal and vertical upper outer border lines of the knee cap.
- E. Mid-point of the crease at the back of the knee cap.
- F. Two thumbs width above the intersection point of the upper border line and inner-border line of the knee cap.
- G. Is located on the inside of the leg just below the bulge on the head of the shin bone.



*Figure 7:- Pressure points for relieving ankle pains, from Bipasha Mukherjere. Acupressure treatment to heal 10 most common body pains. 2017; <https://www.modernreflexology.com>; May 25, 2017.*

The locations of figure 7 pressure points are indicated below:-

- A.** Known as the “Illuminated Sea”, and located one width below the inner-front surface of ankle joint.
- B.** Known as the “Bigger Stream”, located in the centre of inner-depression between ankle joint and Achilles tendon. Also beneficial for swollen feet and strengthens the ankle joint. According to Chen (2017), strong stimulation of this point is not advisable after the third month of pregnancy.
- C.** Known as “High Mountains”, located in the Centre of outer hollow between ankle joint and Achilles tendon; opposite of point **B**. Rheumatism and swollen in foot joints, thigh pain and lower back pain can also be managed with this point (Chen,2017).
- D.** Known as “Calm Sleep”, located in the Centre of outer hollow directly below the outer ankle bone. Relieves pains of sprained ankle,

ankle stiffness, sciatic pains, swollen ankle, insomnia and general health of the foot. The point is also known as GB40 (Gach, 2015).



*Figure.8:- pressure point for foot pains*

Source: Mukherjere, (2017)

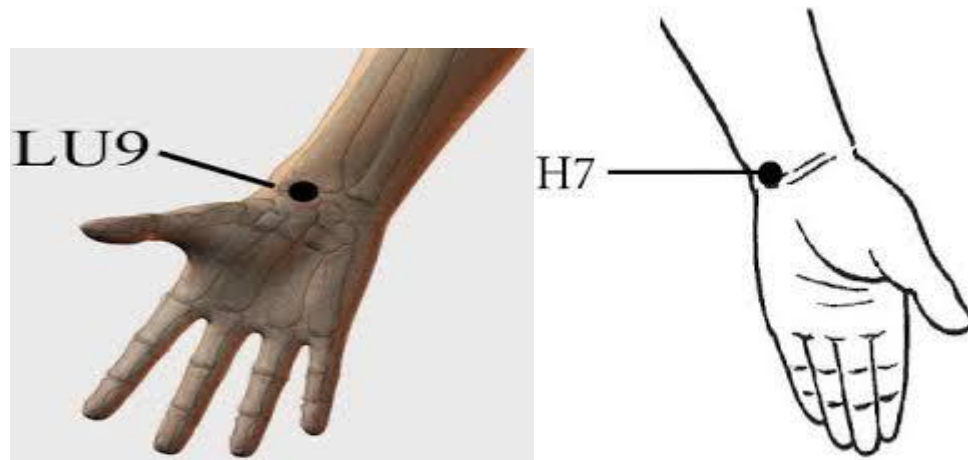
The points indicated on the top of the feet (figure 8) are located between the first and second metatarsal bones. They are known as Taichong LV-3. Their stimulation as additional points for the management of injuries of the leg is highly recommended (Forem, 2014).



*Figure. 9 & 10:- pressure point for shoulder, from Bipasha Mukherjere. Acupressure treatment to heal 10 most common body pains. 2017; <https://www.modernreflexology.com>; May 25, 2017.*

An important pressure point to consider for shoulder pains is the point located in the hollow towards the front of the shoulder joint (figure 9) known as Large Intestine 15 (LI 15) point or the Chien Yu (96 CO 15) point; figure 12. An additional point for the relieve of shoulder pains, stiffness of the neck and back

pains is the point on top of the shoulder muscle, two finger widths out from the distal base of the neck or half way between the base of the neck and the end of the shoulder muscle (figure 10); point **F** of figure 3, known as “Shoulder Well” (Black, 2017).

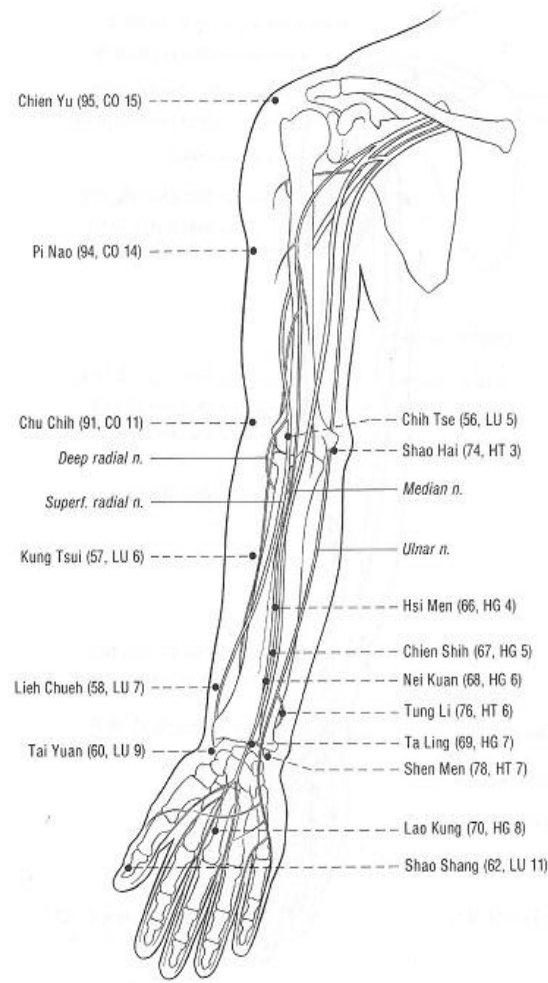


*Figure 11:- pressure points for wrist pain, from Bipasha Mukherjere. Acupressure treatment to heal 10 most common body pains. 2017; <https://www.modernreflexology.com>; May 25, 2017.*

For the management of wrist pains, the two key points to consider are **LU9** and **H7** indicated above. Apart from the above pressure points indicated, another important point, the Union Valley, located in the middle of the flesh between the thumb and the index finger is recommended for all traumatic injuries and the relieve of stress and anxiety (Mukherjere, 2017).

Sports related elbow joint pains and stiffness could also be relieved by utilizing some of the following pressure points on figure 12. According to Gala (2004), working on the points indicated on fig.11 as Shao Hai (74 HT 3), Chih Tse (56 LU5) and the Union Valley point located in the middle of the flesh between the thumb and the index finger will help relieve elbow pains. For the

management of tennis elbow or golfers elbow all the points indicated on figure 12 should be considered for effective treatment (Denver, 2013, Gala, 2004,



*Figure 12:- Pressure points for arm pains, from Bipasha Mukherjere. Acupressure treatment to heal 10 most common body pains. 2017; <https://www.modernreflexology.com>; May 25, 2017.*

### **Healing Powers of Touch**

The art of touch is natural and has been practiced ever since creation. Human touch is very important. It conveys a sense of caring, an important component of healing. Touch, which is the first sense to develop, gives warmth, comfort, pleasure and reassurance. Sick people, old and young, need just a touch

from love ones to renew their vitality. A crying child or a bereaved relative needs nothing, apart from a touch from a love one, to be comforted and to be assured that he/she is not alone. For loving couples, touch is needed for emotional and sensual satisfaction, to express love, affection and caring. Love without passionate touches is an empty love, and the relationship would have no firm roots to survive. It should not be a surprise to know that most of the marital problems in our world have 'lack of touch' as the key factor (Borrelli, 2016).

A friendly and affectionate touch helps the body to release oxytocin (love hormone). Oxytocin contributes to the lowering of blood pressure, decreasing the release of stress-related hormone (cortisol) and increasing pain tolerance. Increasing the amount of touch or massage harnesses the health promoting effects of oxytocin including the lowering of anxiety and promoting a general sense of well-being. A massage after a day's tough workout is a simple natural way of preventing body stiffness and soreness, management of pain and the promotion of healthier body and mind (Dacher, 2013).

The findings of a study by Coan (2006) revealed that the subjects (women), experienced less pain from an expected mild shock when they were holding a stranger's hand. With the same intensity of shock, they experienced least pain when holding the hands of their husbands. Another study revealed that a touch by women in pain by their husbands led to an instant drop in activity in areas of the brain involved in pain, fear, and threat (Dobson, 2006).

A simple act of touching is said to be so powerful that it can increase levels of endorphin to reduce pain, slow down heart rate and strengthen the immune

system. Touch also leads to the release of dopamine, endorphins, melatonin, oxytocin, and serotonin to relieve pain and to promote good feeling and wellbeing. Dopamine, endorphins, oxytocin and serotonin are the quartet responsible for our happiness (Body Ecology, 2017, Dobson, 2006, & Huffington, 2014).

Touch boost immunity by increasing the number of lymphocytes, reducing levels of cytokines which are major players in inflammation and causes a reduction both cortisol and vasopressin, a hormone that plays a role in aggressive behavior. The American Association for Cancer Research (2011) has also revealed that beta-endorphins suppresses stress response, promotes immune function, elevates levels of anti-inflammatory cytokines and reduces levels of inflammatory cytokines as well as inhibiting tumor progression. Touch in the form of massage increases delta waves (brain waves) connected to deep sleep to reduce fatigue and pain. An antidote to a stressful day, relationship woes or ailments could therefore lie right at our finger tips (Borreli, 2016).

According to Smith (2015), a touch on the vagus nerve, the longest cranial nerve with the widest distribution in the body, slows heart rate, decreases blood pressure, helps digestion, slows down the release of stress hormones (cortisol) and increases level of serotonin, an important ingredient of anti-pain and anti-depressant medications. A study on touch at the Institute of Neurological sciences in Glasgow (2000) also revealed that touch lowers heart rate and blood pressure. A follow up study at Duke University in Durham, North Carolina (2002) confirmed that, touch and massage can cut levels of stress hormones which have been implicated in increasing the risk of a number of diseases.

When people refuse your hand shakes or touch you, the meaning and emotional effect on health is not good. It tells you that you are no more a friend or wanted by the group or society. This sign of rejection is painful and can lead to loneliness, depression and other serious emotional and psycho-social health effects. It is important to realize that the cuddles, strokes and the carrying of babies at the back of mothers and on the chest and shoulders of fathers help them to build a healthy emotional and social image of themselves. An American psychologist, Sidney M. Jourard (1971), is cited to have revealed in his study on “Physical Contacts and Self- Disclosure” that our perception of how much we are touched by other people seems to be clearly related to our self-esteem, and how much we value ourselves (Harvard Health Publishing, 2017).

Touch is also an instinctive action to manage pain or any traumatic injury to the body. When people are suffering from headache or stomach pain the first thing they do is to hold their head or stomach. A child suffering from a painful finger will run to the mother for the comfort of he or she believes will get from the hold or touch of the mother. Cut your finger with a blade, and the natural response is to hold that same painful cut for comfort. Even animals know that by licking a wound or a painful limb, they will feel better (Lidell, 2007).

### **Endorphin Release Therapy**

Endorphin Released Therapy (ERT) is a holistic natural therapy developed from neurology and civil engineering principles. The godfather of the therapy is John Carty, an Irish civil engineer. According to him, the therapy was developed in 1993 after his daughter injured her back in a gymnastics accident. The only



option to save the girl was a surgical operation which he refused. With his civil engineering background he began to research into alternatives till he eventually came up with a hands-on treatment that worked. According to Carty (2006), ERT works by stimulating the nerves to release endorphins. He explained that most pain is brought on by nerve damage but not due to muscular or skeletal structure damage most people think. The damaged nerves bring about pain, muscle spasms and restrictions in movement. Therefore, by encapsulating the damaged nerve with endorphins, by the use of ERT, the muscles automatically come out of spasm, pain and any restriction within some few minutes (Carty, 2006).

Endorphins are natural pain relieving chemicals (neuropeptides) possessing morphine-like effects, and stored in the anterior part of the pituitary gland (Graham, 2006, & Sprouse-Blum, Smith, Sugai, & Parsa, 2010). It has been revealed scientifically that endorphins interact with the opiate receptors in the brain to reduce perception of pain, just as drugs like morphine and codeine. However, endorphins do not lead to addiction or dependence. Apart from the reduction of pain, other notable physiological benefits such as the release of sex hormones, feelings of euphoria, modulation of appetite, enhancement of the immune response and the feeling of fewer negative effects of stress are experienced when endorphins are released. It should however be noted that endorphin release varies among individuals (Narins, 2014 and Stoppler & Shiel, 2014). According to Stoppler and Shiel (2014), the two most common factors leading to the release of endorphins are stress and pain. It is interesting to know that, the ERT practitioner takes advantage of the above scientific fact to create

pain with finger pressure for the release of endorphins. Endorphins are released into the blood stream when identified pin-pain points or pressure points on the body are systematically manipulated or pressed with finger tips. The pain signals move in the form of bio-electricity or bio-energy through nerve paths or meridians which run through the body from head to toe to activate damaged cells, tissues and nerves to function. This preparation promotes the rapid flow of released endorphins and other related body chemicals like dopamine and oxytocin into the blood stream to block pain signals from reaching the brain. As a result pain signals will not be available for it to be interpreted as pain. The released hormones help to promote healing and good feeling throughout the body for total well-being (Gala, 2004). Endorphin Release Therapy is similar to acupuncture in practice. Finger tips are used to trace pain on related nerves of identified or diagnosed malfunctioning organs, to regulate and direct the flow of released endorphins, just as the meridians of the body will be followed in acupuncture (Gala, 2004). The ERT therapist is able to diagnose correctly by the severity of pain, after a slight touch on a point on a nerve. Such nerve pains on a damaged nerve are very sharp and piercing. They are known as pin-pains. Normal dull touch pain is not considered as a symptom of health problem or a disease (Gala, 2004, Ratini, 2016, & Smith, 2015). It is usual to see diagnosing and treatment starting from the proximal to the distal part of the body, hence the popular jargon, “chase the pain out”. During the treatment, the ERT therapist will break intermittently to shake and spill the fingers to energise the fingers. After some minutes of stimulations at pain points, the pains vanish or reduce

drastically. Most patients sleep in the process when the sedative effects of endorphins are released. Patients also feel refreshed and lighter in weight after a session of about 30minutes to 60minutes depending on the physiological state of the client, and whether pain-killers of any kind have been taken before the treatment (Carty, 2006).

The powerful medium of “touch” is what ERT uses to help the body to heal itself without any debilitating side effects. Touch leads to the release of dopamine, endorphins, melatonin, oxytocin, and serotonin to relief pain and to promote good feeling and wellbeing (Dobson, 2006). Dopamine, endorphins, oxytocin and serotonin are the quartet responsible for our happiness (Huffington, 2014). The American Association for Cancer Research (2011) has also revealed that beta-endorphins suppresses stress response, promotes immune function, elevates levels of anti-inflammatory cytokines and reduces levels of inflammatory cytokines as well as inhibiting tumor progression.

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The related pain of an injury starts reducing and vanishes after some few minutes of manipulation at identified pain point to indicate that healing has taken place. Inflamed soft tissues of the body also start reducing gradually along with the pain reduction (Gala, 2004). The accompanied sedative effect of ERT also

helps some patients to sleep deeply to relax the whole body after a long session. After a short session of 10 minutes to 20 minutes, depending on the physiological state of the client, the patient feels happy, refreshed and lighter in weight. The good feeling clients' exhibit after a session of ERT is enough to restore the lost energy, strength and painful fingers of the ERT practitioner (Carty, 2006). Pressing down too hard on painful tough muscles causes fingers to flex upwards, leading to pain in the wrist and hands. Crawford (1998) has revealed that physical therapist turn to absorb released pain of clients in the form of negative electro-magnetic waves into the hands. This affects the energy systems to drain their psychic level. As a remedy, he suggested an intermittent break for stretching or immersion of the painful hands into cold water for 5 minutes. However Crawford's suggestion goes against a basic principle of massaging which prohibits hands-off breaks (Lidell, 2007). A simple way ERT practitioners use to relieve stress and absorbed negativities is the intermittent snapping of fingers, which is unique and has been attracting questions from curious clients (Carty, 2006). This is a fertile ground for the growth of perception which is often based on incomplete and unreliable information, therefore it is necessary to neutralize perceptions with research findings on most practical phenomena such as ERT to guide human behavior in general (Business Dictionary, 2016). Endorphin Release Therapy has been used to manage different health problems including musculo-skeletal sports injuries and paralysis of leprosy successful. According to Dr. Michael Corry, a consultant psychiatrist and psychotherapist of Clane General Hospital, Ireland, sometimes ERT

succeeds where others fail (Corry, 2006) making ERT a good therapy for musculoskeletal pains.

### **Common Sports Injuries and Common Therapeutic Management Modalities**

Four musculo-skeletal sports injuries commonly found in sporting arena during competitions are muscle cramp, sprain, tennis elbow and knee ligament injury. Different therapeutic modalities commonly used to manage the four above named sports injuries will also be mentioned. A Muscle cramp, also known as Charley horse, is a sudden painful contraction or tightening of muscle fibres or a group of muscle fibres (Cambridge Dictionary, 2016).

A Muscle cramp is an involuntarily action which last from a few seconds to several minutes and often occurs in the leg. A common example is the night-time leg cramp which usually happens due to sudden tightening or spasms of muscles in the calf. Muscle cramps can also happen in the thigh or the foot during physical activities, resting or when waking-up from sleep (Jones, 2016). Signs and symptoms of muscle cramp ranges from a mild nuisance to incapacitating: stiff muscles and joint, and extreme pain. Muscles could be visibly distorted or knotted making the area firm to touch. Twitching of muscles may also be evident (Jones, 2016; Stoppler, 2015). Muscle cramps in general, have been attributed to so many causes among which are the overuse of muscles or injury during exercise, decrease amount of sodium, calcium and potassium in the blood, exposure of muscles to cold temperatures when performing, dehydration, sitting or standing on a hard surface for a long period of time, poor medical condition and problems such as kidney and thyroid diseases. It is very interesting to know

that medications like antipsychotics, birth control pills, diuretics, statins and steroids may interfere with the electrolyte level of the body which contributes to the breakdown of muscle tissues and blood flow to functioning muscles. Muscle cramps are not cause for alarm; however, they may be a sign of a serious health problem like liver cirrhosis, spinal nerve problems or atherosclerosis (Kumar, 2001).

There are four (4) types of muscle cramps namely, true cramps, tenany, contractures and dystonic cramps. True cramps, are believed to be caused by the hyper excitability of the nerves that stimulate muscles. It is also known that, after an injury, muscle cramps may occur as a defensive mechanism to minimize movement and to stabilize the area of injury. True cramps are also commonly associated with vigorous and strenuous muscular activities. The over exertion caused due to the prolonged repetitive use of the muscles in working, sitting or standing leads to such muscle cramps during or after the activity.

Dehydration, which usually occurs during sports and other vigorous physical activities due to the excessive loss of fluid through perspiration, is another cause of true muscle cramp during warm weather. The loss of water during warm weather is a very serious situation which needs attention because it leads to high levels of skeletal muscle temperature which is not conducive for efficient muscular performance. The situation can lead to heat stroke which is a serious health problem on its own. The loss of water through perspiration does not only cause dehydration but it also brings about the loss of vital blood minerals like calcium, sodium and magnesium to cause electrolyte imbalance, an important

condition for excitability of both nerve endings and muscles they stimulate. The unusual distribution of body fluid in the body can also produce true muscle cramp. Cirrhosis of the liver triggers the accumulation of fluids in the abdominal cavity and kidney related issues which deprive the skeletal muscles the much needed water for normal effective and efficient functioning (Stoppler, 2015).

The second type of muscle cramp is known as Tetany or tetanic cramp. The name originated from the negative effect of tetanus toxins on nerves. With this type of muscle cramp, there is an activation of all nerve cells in the body to fire up muscle spasms and cramps (Herber, 2010; Stoppler, 2015)).

Low blood levels of calcium and magnesium in the body usually increase activities of nerve tissues ambiguously. This condition is very fertile to trigger tetanic cramps which are in most cases accompanied by hyperactivities of other nerves in addition to muscle stimulation. It is a common knowledge that, apart from causing spasms in the hand and wrist muscles, low calcium in blood could lead to numbness and tingling around the mouth and other areas (Stoppler, 2015). It is a difficult task to differentiate between true muscle cramp and tetany simply because the exciting changes and other nerve functions which accompany tetany are camouflaged by the pains of the cramp (Jones, 2016).

Contracture is the third type of muscle cramp to be discussed as a type of muscle cramp. A contracture occurs when one of the opposite muscles; the agonist or the antagonist muscle, shorten or tighten in a static mood to disallow the normal flexion and extension action of a joint. An example of this condition is when the bicep muscles of the upper arm cramps up or shorten to keep the

elbow joint stiff and bent permanently. Contractures can also occur when a limb is not moved regularly through its full range of movement or is maintained in a particular way for a long time due to the weakness or strength of the muscle, injury or disease of one of the opposing muscle group of a joint. Sick and weak children in bed for a long time can easily develop contractures because of lack of movement. Stroke and paralysis are common diseases which cause contractures of the wrist, elbow, knee, ankle, toes and even fingers due to the weakness of most of the muscle groups, leading to bending of the above named joints towards the shortened muscle group of the joint (Stoppler, 2015).

It is known that the correction of contractures is not an easy task. The process is very slow, uncomfortable, painful and costly when surgery is to be used in advanced cases. Prevention through regular stretching and maintenance of good posture is therefore the best (Jones, 2016; Stoppler, 2015).

The fourth type of muscle cramp is dystonic cramps. With this type of muscle cramp, muscles that are not needed for any intended action are rather stimulated to contract. It is rather interesting to know that, muscles usually affected in dystonic cramps extend to include muscles that usually work in opposite direction of intended movement. Dystonic cramps are not common, but arms and hands may be affected when performing repetitive activities associated with handwriting, typing, playing of some musical instruments and many others. It has also been known that small muscle groups, including that of the eyelids, jaws and neck are occasionally affected by some dystonic cramps (Jones, 2016; Stoppler, 2015).



Muscle cramps in general could be prevented if the body is regularly exercised. An important precaution to remember before the commencement of any sports is that, a proper warm –up should be done to heat up the soft tissues of the body in preparation for the on-coming vigorous physical activity. The stretching aspect of the warm-up session is often neglected, but that is one of the most important remedies for the prevention of muscle cramps (Winsper, 2016).

Drinking plenty water and nutritious fluids before, during and after exercise, in addition to the eating of fresh fruits; including coconut and banana, to boost up the levels of body fluid and electrolytes are highly recommended. It is also good to add a bit more of salt to the food eating during warm weather to replenish lost minerals through perspiration and other means. During cold weathers, warm clothing should be used before and after activities to keep the muscles warm and ready for action (Sloane, 2008; Young, 2017).

Stretching and massaging of cramped skeletal muscles are the most common therapeutic modalities used by most people to manage such sports injuries. It is also good to administer cool water, or fruit juice to casualties, as well as rubbing the cramped muscle group with wrapped ice pack to cool down the temperature of the injured muscle. Muscle relaxants are also available means to manage muscle cramps (Grisogono, 2009; Pandey, et al., 2007; Winsper, 2016).

Sprain is the second musculo-skeletal sports related injury that would be discussed. A sprain is a ligamentous injury which may result due to so many traumatic factors including falling during an activity and twisting of the ankle

when one steps wrongly on an object. In a game situation, a sprain may occur when tackled in football and the ankle rolls outward while the foot turns inward causing the ligament on the outside of the ankle to over stretch and tear. It is not common to witness an ankle sprain with the foot turning outward (Scott, 2017; WebMD, 2015). A sprain could be diagnosed to be either mild or severe. A mild sprain has no serious damage to a ligament, but it is characterized by tenderness, swollen and stiffness of joint. There is some stability and walking can be done with little pain. A severe sprain, on the other hand, could reveal bruising, joint deformity and tenderness around ankle. Walking is not possible due to weakness, absence of stability and severe pain. A pop or a snap sound could also be heard when the damage is severe. It also takes a longer time to heal (Scott, 2014; WebMD, 2015). Normally a sprain is managed by following the “RICE” principle. A lot of rest is needed when the injury occurs. Walking should be done carefully with the use of crutches because repeated sprains can lead to chronic joint pain and weakness. The application of ice soon after the injury is very necessary to reduce and prevent further swelling of the injured joint. For the first 24 -72 hours, an ice pack should be applied for 10 -20 minutes, every 1 hour or 2 hour intermittently during the day. Care should be taken to wrap the ice pack with a gauze or handkerchief to prevent direct contact of the skin with the ice pack (Grisogono, 2009; Young, 2017).

Apart from the above, the ice pack should be pressed firmly against all corners of the affected area. Ideally the ice pack and the injured joint should be compressed with an elastic compression wrap or an ACE bandage for the initial

24 -36 hours to ensure stability and to help reduce swelling. For the injured joint to carry weight comfortably, a brace should be worn for joint support (WebMD, 2016). Elevating the injured joint over and above the heart level for 2- 3 hours daily, helps in reducing swelling. It also goes a long way to reduce pain and speeds up the healing process (Grisogono, 2009).

To ensure proper healing, rehabilitation exercises including functional stretching and strength exercises should be carried out to prevent the development of chronic joint pain, weakness or the reoccurrence of the injury. Before an athlete could return to active sport, a simple “hop” test with the injured ankle should be done. A feeling of pain in the treated joint, during and after the “hop” test is an indication that healing is not complete (WebMD, 2015). Sprains could be prevented during sports if proper warm-up, including the stretching of joints though their maximum range of movements is done. Other preventive measures include taping of joints, wearing of brace, wearing of appropriate sports shoes and lacing – up of sports shoes (Grisogono, 2009; Sloane, 2008; Winsper, 2016).

Tennis Elbow is the third sports injury for discussion. Other popular names of Tennis elbow are Hooter’s elbow and Archer’s elbow. Tennis elbow is known medically as lateral epicondylitis, meaning the inflammation of the outside elbow bone. It is also described as lateral epicondylalgia or simply lateral elbow pain (Medicalnewstoday. 2014).

Tennis elbow is a musculo-tendinous injury believed to occur due to the strenuous overuse of the muscles and tendons of the forearm and around the

elbow joint. The tendons mentioned are attached to the lateral epicondyle of the humerus. However tennis players also think that the injury is caused by the repetitive nature of hitting of tennis balls leads to tiny tears in the forearm tendon attachment at the elbow. The constant usage of scissors, swimming, throwing events in athletics, the snap or flick movement of the wrist during racket games and many other manual activities bring about painful extensor muscles (Krafts, 2010). The peak incident of tennis elbow is between 30 – 60 years of age and can affect both men and women.

The major symptom of tennis elbow is pain which last for 6 – 12 weeks. The pain is recurring, and usually felt at the outside of upper forearm, just below the bend of the elbow. The Pain may also be felt downward towards the wrist. Casualties may feel pain during lifting and bending of arm, writing, when gripping small objects, when twisting forearm or extending forearm fully. Tennis elbow could be diagnosed better by the use of ultra sound scan since it can reveal damaged muscles, tendons and other soft tissues. A recommended very simple home test that could be used to diagnose tennis elbow has been highlighted as follows; firstly, stand behind a chair. Secondly, place hands on top of the chair back with palms down and lastly, try to lift the chair up. If pain is felt on the outside of ones elbow, during the lifting up of the chair, then one may be suffering from tennis elbow (Medicalnewstoday, 2014).

The orthodox therapeutic modality for managing tennis elbow considers rest as an important option. About 2 – 3 weeks of complete rest is needed to promote the natural healing of the tiny tears in the tendon attachment. The use

of an ice pack is also necessary to reduce or halt any inflammation. Massage and stretching of the muscle and tendon could also be followed with progressive strengthening exercises with weight or elastic bands to promote forearm and grip strength is very beneficial. The use of cortisone injection to help reduce inflammation, extra-corporeal shockwave therapy, heat therapy, trigger point therapy and surgery to remove the damaged part of the tendon to relieve pain are all available to manage tennis elbow (Kraft, 2010).

As a preventive measure tennis and other racket game players should be able to strengthen their shoulder rotator cuff, scapula-thoracic and abdominal muscles to help reduce any over compensation in the wrist extensors during gross shoulder and arm movement. A good warm-up, including gently stretching of arm muscles and joints before play is necessary. Heavy rackets should be used by stronger player, while weak players go for lighter rackets to avoid unnecessary stress on arm muscles and tendons. Weight training is also recommended to develop arm strength. Arm braces, bands and wrist splints are all available to help prevent tennis elbow as an injury (Howard, 2017).

Finally, patella tendonitis, popularly known as jumper's knee is an injury very common to athletes involved in jumping and landing events like long jump, triple jump, high jump and basketball. The injury is believed to be caused by repetitive stress on the patella tendons connecting the knee cap to the shin bone, or the quadriceps tendon to the patella. It is revealed that, the patella tendon experience greater mechanical load during landing than during jumping due to

the muscle contraction of the quadriceps. Over-training and training on hard surfaces are basic risk factors to the jumper's knee (Sloane, 2008).

Four stages of the injury can be identified. During stage 1, the victim will experience pain only after an activity. With the stage 2, the victim will be able to play satisfactorily, but with pain during and after activity. Stage 3 comes with prolong pain during and after activity to the extent of not allowing the victim to function satisfactorily. The fourth stage comes with a complete tear of the tendon which could only be managed by a surgeon (Prezi, 2012; Sloane, 2008; WebMD, 2015). Common signs and symptoms are the tenderness of the area of attachment of the patella tendon to the shin bone. Tightness of the hamstring and the quadriceps are also evident during patella tendonitis. From the orthodox medical point of view, during the stages 1, 2 and 3 of the injury, there should be a reduction in activities which increase patella-femoral pressure, but should concentrate more on gentle eccentric loading activities. Jumping and squatting activities should be stopped (Mair, 2014; Prentice, 2006). Cryotherapy is also recommended for management of pain. The application of ice is for a duration of 20 -30 minutes, 4 – 6 times a day after activity, coupled with stretching and strength building exercises could be of excellent help (Grisogono, 2009, Sloane, 2008; WebMD, 2016).

**Effects of Age; Gender; Years of Participation in Active Sports; Number of Previous Injuries and Part of Body injured on Recovery from Injuries.**

Apart from literature, practical experience has revealed that sports is an enjoyable activity, however, it is accompanied with injuries. The effects of

factors such as age, gender and years of participation in sports on injuries are therefore worthy to be considered.

### **Age**

The effect of age on sports performance and injury is of great importance due to the accompanied physiological changes. According to Minson (2015), the best age range for active sports is from mid-twenties (20s) to early thirties (30s), after which strength and endurance decline by 1-2% per year. He also explained that, ageing leads to decline in sports performance because of inefficient use of oxygen, stiffness of soft tissues and slow recovery from injuries.

Vitelli (2014) has also mentioned that bodies of ageing people heal slowly and therefore experience pain longer. He has also revealed that as a person is ageing, the metabolism of some hormones slows down. Ageing affects the effect of some hormones on the function of organs of the body. The pituitary gland which produces endorphins reaches its maximum size in middle age, and gradually reduces in size and in the production of endorphins. This may explain why pains are sometimes difficult to manage with physical therapy during old age (Gambert, 2008; Morley, 2018).

Muscle decrease in number and shrink in size as we age. New muscle fibres are also generated at a slower rate in older people than in younger people. This results in a slower building and strengthening of muscles in response to the incidence of recovery from injury (Cohen & Gould, 2012).

## **Gender**

The effect of gender on the rate of recovery from injuries has also of great concern. An experiment conducted by Kempen, Sanderman, Scarf-Klomp and Ormel (2009) on gender differences in recovery from injuries to the extremities in older persons, revealed that the male participants recovered faster than their female counterparts.

Research findings of Ferber et al. (2007); Herber (2010); Sallis et al., (2001); Shmerling (2015); Taunton et al. (2002) and Wick (2014) have revealed that females are more susceptible to sports injuries than males because of their anatomical and physiological make-up. Considering the rate of recovery from injuries, hormonal difference in gender has been noted as a vital factor when considering differences in injury recovery rates.

Testosterone, which is more in men, is known to promote protein synthesis which is critical for the development of larger muscles, muscle repair and growth. This explains why males recover more quickly from injury and workouts than females (Byer, 2016; Putukian, 2012; Sipski, Jackson, Gomez-Marin, Restores & Stein, 2004).

## **Years of participation in active sports**

Early participation in sports is one way for the youth to remain active, have fun, develops friendship and to lead a healthy lifestyle. However, early participation may lead to long-term consequences from injuries. Scientific evidences are now showing that, the wear and tear of tissues during competitive sports can cause lifelong damage if started too young.



The common types of injuries experienced by young athletes are overuse injuries. According to the American Medical Society of Sports Medicine position statement, overuse injuries may occur due to continuous submaximal loading of the musculo-skeletal system when rest is not adequate to allow for structural adaptation to take place” (DiFiori, 2014). It could therefore be deduced that when young bones, muscles and other soft tissues are excessively used, they deteriorate till a major injury occurs. These injuries often manifest as minor acute injuries, and are not well managed. The overuse of these poorly managed injuries leads to chronic injuries which are difficult to manage (Maffulli, 2005; Rogers, 2009). Injuries of young athletes who did not start playing competitive sports early do not often become overused and chronic, therefore they heal at a faster rate (Kraemer,2009: Tillye, 2012).

### **Number of previous injuries**

The problem of the number of previous injuries of an athlete having an effect on the healing rate of new injuries is also of much interest to consider. Most previous injuries of active sports participants become overused injuries due to lack of rest and effective management (Maffulli, 2005; Rogers, 2009). These overused injuries become chronic and difficult to manage. They are also susceptible to new injuries at the same spot of the previous injuries (Jin, 2010).

Dr. Tan Ken Jin (2010) has also mentioned that people who sustain strain injuries are liable to suffer from mobility and flexibility related problems. He has however warned coaches and athletes to prevent injuries. According to Dorherty (2012) fractures and injuries near joints significantly increases one’s risk of

developing arthritis after 15 to 20 years. All these facts indicate that the number of injuries sustained previously affects negatively, the injury recovery time of new injuries and the physical wellbeing of the individual in the long run.

### **Part of body injured**

Known facts in Zoology about living organism is that, tissues closer to the brain, regenerate, repair and heal faster than tissues further away from the brain. The slow healing of the feet or toes should therefore not be a worry (Routenberg, 2014). For injuries to heal faster, Berardi (2012) has recommended the eating of right food, taking appropriate food supplements and glucosamine, homeopathic creams and gels, and the drinking of plenty water.

Healing time naturally varies amongst individuals; however Quinn (2018) has mentioned that people with better blood supply heal faster than those with chronic illness or those with sedentary lifestyles having. A good blood supply transports nutrients, oxygen and infection-fighting cells to damaged areas to enhance physiological activities needed to promote faster healing (Berardi, 2012; Quinn, 2018). If the above fact is considered, then it should be normal to see injured body parts closer to the heart also healing faster than injured body parts away from the heart.

### **Appraisal of Reviewed Literature**

Among the literature reviewed are the theories of pain; being the Intensity theory of pain, Specificity theory of pain, Pattern theory of pain and the Gate control theory of pain. They explained the physiological basis of pain and

mechanisms underlying pain perception, although these theories have not yet completely accounted for all aspects of pain perception.

The reviewed literature also mentioned the presence of an endogenous analgesic system in mammals, including human beings, which release endogenous opioids like  $\beta$ -endorphins, enkephalins and dynorphins. Endorphins are known to act on opioid receptors located at the nerve endings of both primary afferent (sensory) nerve and the projector interneuron to block neurotransmission of pain signals (Biological Sciences, 2017, Carroll, 2016, & Wlassoff, 2014).

Reviewed concepts on ROM revealed some relationship between pain and ROM. Postulated concepts on ROM by some experts made it clear the effect of endorphins on stiff soft tissues which restrict ROM at the joints ( Hargrove 2008; Johnson, Kim, Yu, Saliba, Grindstaff, 2012).

Literature reviewed on the central nervous system, pressure points, and the healing power of touch, confirmed that the human body has the capacity to heal itself when some specific points or areas of the body are touched, or the soft tissues of the body are manipulated. Available studies confirming the healing effects of massage, acupressure and others physical therapies in the management of some common sports injuries were also reviewed.

There was no literature on studies conducted to prove scientifically the effect of ERT on traumatic pain and restricted ROM. Available means used to prove the effectiveness of ERT in the management of some sports injuries and other health problems were testimonies written by recipients or clients of John Carty and other ERT practitioners. The lack of available studies to make known

scientifically the effect of ERT on traumatic pain and ROM, indicates a knowledge gap. This knowledge gap needs to be filled, hence the purpose of the study.

## CHAPTER THREE

### RESEARCH METHOD

The purpose of this study was to ascertain the effect of ERT on pain and ROM among injured SHS athletes in the Central Region of Ghana. Sports injuries management has been an interesting area of concerns in the contemporary world of sports. This has been the case because apart from their related pain and limited ROM having negative effects on sports performance, they also create some socio-economic burden on individuals and countries (Bigos et al., 2010; Bonica, 2007; Lidell, 2007; Wuhrman et al., 2011). The search for effective therapeutic modalities for the management of sports injuries is therefore in the right direction.

Among the sub-headings to be discussed under this chapter are research design, study area, population, sample and sampling procedure, data collection instruments, data collection procedures, data processing and analysis and chapter summary.

#### **Research Design**

The study was quasi-experimental in nature. It followed the quantitative research methodology. The phrase “quasi-experimental” indicates that the study was not a true experimental research. Though the independent variable is manipulated before an effect on the dependable variable is measured in quasi-experimental studies, participants are not randomly selected (Collie & Hussey, 2003; Sidhu, 2007).

By their characteristics, quasi-experiments are also ideal for the evaluation of the effectiveness of an intervention or treatment which is in line with this study. In addition, an experimental design has the ability to explain some kind of causations, or to predict phenomena based on the concept of cause and effect (Lanndow & Everett, 2014).

The pre-test post-test (one group) design was employed because it enables the researcher to have a good idea about the conditions of the participants before the application of the intervention. It also makes it possible to determine whether the manipulation of the independent variable causes subsequent changes in the dependent variable (Kowalczyk, 2018, Salkind, 2018 & Shuttleworth, 2009).

A limitation of the pre-test post-test design is that, pre-test might sensitize participants to experiment treatment. This condition might also lead to bias post-test scores; a threat to internal validity (Boyd, 2018; Trochim, 2006).

### **Population**

The population of the study was drawn from Central Region of Ghana. Central Region; the area of study, is one of the ten administrative regions of Ghana. The region has a population of 2,201,863 (2010 Census) on a total land area of 9,826 km sq. Cape Coast is the capital among other 16 Municipal and District Assemblies. Central Region borders Ashanti and Eastern Regions to the North, the Gulf of Guinea to the South, Western region to the West, and Greater Accra region to the East (TipTopGlobe, 2017).

Central Region was selected for the study because whilst coaches from other regions were reluctant to accept the use of ERT to manage the injuries of their

athletes, the Regional Physical Education Coordinator and his coaches accepted for the use of ERT to manage the injuries of their athletes.

The population for the study was made up of SHS athletes in the Central Region who were selected to compete for the Region during the 2017 Schools and Colleges National Sports championship held in Cape Coast. According to Mr. Albert Kofi Bonney, the Central Regional Physical Education Co-ordinator in the year 2017, the total number of selected SHS athletes for the annual sports festival was 244. This number of athletes was made up of males and females participating in athletics, soccer, basketball, netball, and other sporting disciplines. It was from the population of 244 that injured athletes were purposefully sampled as participants for the study.

### **Sampling Procedures**

A purposive sampling procedure was utilized to select participants. The total number of 62 SHS athletes who accidentally sustained injuries involving the lower and upper limbs during the 2017 Schools and Colleges National Sports championship, were involved.

The sample, made up of 38 (61.3%) males and 24 (38.7%) females with ages ranging from 16- 23 years, could be described as homogeneous because they all graduated from JHSs in Ghana. It has been recommended by Sauro (2013) that it is better to use small sample size for experimental research work if the population of the study is homogeneous.

A percentage of 14.5 participants were from Winneba SHS, followed by 12.9% each from Obrakyire SHS and St. Augustine's College, and 9.7% each were also from Adisadel College and Mfantsipim School.

Apart from the above, 8.1% were from Cape Coast International SHS, and 6.4% each from Ghana National College, Wesley Girls SHS and Obiri Yeboah SHS. Lesser percentages of 4.8%, 3.3%, 3.3% and 1.6% participants were from Holy Child SHS, Apam SHS, Swedru SHS and Edinaman SHS.

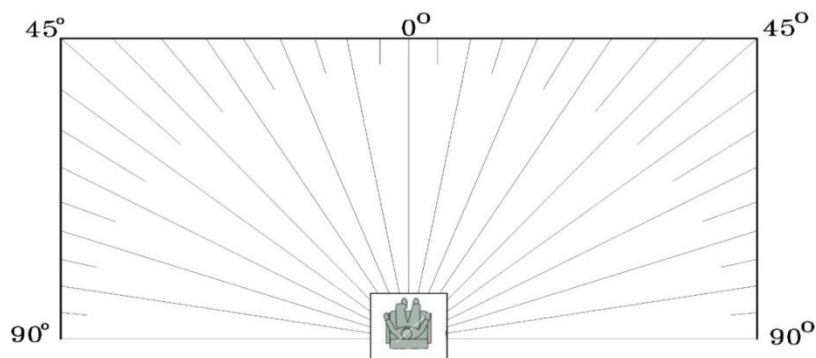
### Data Collection Instruments

The instruments used included the Orthopedic Mobility Scanner (OMS), standard goniometer and the 0-10 Numerical Rating Scale.

#### Orthopedic mobility scanner

The OMS was invented by John Carty and has two patents from Ireland and United Kingdom as a neck (cervical vertebrae) ROM measuring apparatus with patent Nos.S83578 (see Appendix C) and GB2401681 (see Appendix D). The OMS is valid with reported reliability coefficient of  $r = .98$  (Bermingham, 2003).

Figure 13:- Orthopedic mobility scanner room





For the use of the OMS on the field, a 3-dimensional made-shift therapy room, as illustrated by figure 13, was constructed with plywood. The inner length, width and height of the 3 dimensional wooden structure were 180cm, 90cm and 90cm respectively. The dead centre of the length of the plywood was marked “0”. From the “0” point, a scale of 18 equally calibrated divisions labeled 5°, 10°, 15°, 20°, 25°, 30°, 35°, 40°, 45°, 50°, 55°, 60°, 65°, 70°, 75°, 80°, 85°, 90° were marked to the right and to the left of the 3-dimensional structure. Within each of the 18 calibrated divisions, five (5) sub-divisions were marked to indicate the points of other angles within the marked and written angles. A centre point measuring 90cm from the “0°” and “90°” points marked on the length and widths of the room was marked on the floor for the placement of a chair.

***Procedure:***

1. A subject (injured athlete) was asked to sit upright on the chair placed at a measured centre point of the room.
2. A brief about the instrument and procedure was given to a subject.
3. A subject was given the OMS helmet to don.
4. The spirit level of the helmet was checked to ensure the attainment of horizontal and vertical equilibrium.
5. The laser light was switched on to ensure the beam is straight on the “0°” mark.
6. With the shoulders well aligned to the 90° marks on the side walls, a subject was asked to turn the head only, to the maximum point on the right.

7. The angle on which the laser beam falls on the wall was recorded as a pre-test score.
8. A subject was asked to turn and look straight to the centre point for the laser beam to fall on “0°”. From that position the subject was asked again to turn the head only, as at step “6”, to the left for another pre-test score to be recorded.
9. The researcher then proceeded to work on painful points around the base of the head and the neck with finger manipulations.
10. Steps “6 - 8” were repeated until there was a relieve after which the post-test scores was recorded after the ERT intervention.

### **Standard goniometer**

Another instrument that was used in the study is a standard goniometer. The standard goniometer is also known as the therapeutic goniometer. It is used by physical therapists and other healthcare professionals to measure client’s joint ROM. The name goniometer was derived from two Greek words, “gonia” meaning angle, and “metron” meaning measurement (McLaughlin, 2010). It is a light portable instrument made of plastic or metal.

Extant literature has mentioned Gemma Frisius, a Dutch physician, mathematician, cartographer and an instrument maker to be the first to describe goniometer around the year 1538 (PT Notes, 2017). The two main parts of the goniometer are the proximal (stationary or fixed) and distal (movable) arms. The proximal arm extends from a central disc calibrated with 360° scale marked in one degree increment. This part does not move during measurement of ROM.

The distal arm, on the other hand, is movable and rotates on the circular disc to measure ROM in degrees of joints of lower and upper extremities (Pain Community Centre, 2014).

***Procedure:***

1. The centre of the disc was placed over the fulcrum of the joint at the outer side of the limb involved.
2. The proximal arm of the goniometer was placed on the proximal part of the limb to the body, along the centre of the bone and hold firmly with fingers.
3. The distal part of the goniometer was placed firmly on the moving (distal) part of the limb involved.
4. The stationary part of the limb was stabilized and then asked the client to move the movable (distal) part of the injured limb.
5. A look at the reading of ROM on the disc in degrees was made before removing the goniometer to record accurately.
6. Note was taken of the landmarks of the arms of the goniometer on the body to ensure consistency.

The standard goniometer was used because it is light, portable, low cost and easy to use. Also, it enables the therapist to visibly measure degrees of ROM lost due to an injury, and ROM gained after an intervention. Available literature has also confirmed the validity of the standard goniometer as a measuring instrument for the ROM of joints of the upper and lower limbs, having good to excellent reliability levels;  $r = 0.90 - 0.99$  (Ferreira de Carvalho, Mazzer & Barbieri,

2012), although the device is of a low level reliability for the measurement of trunk range of motion (Ferreira de Carvalho et al., 2012).

Apart from the above noted limitation, there are some difficulties in placing the goniometer properly, as well as stabilizing the body and the goniometer during measurement. Problems faced when performing the correct anatomical movement could also affect the reliability and validity of the instrument. However, these problems were solved with training and the measurement of each ROM three times. The medians of the three ROM measurements of each affected joint were recorded as the correct ROM measurements (Nussbuamer, Leunig, Glatthorn, Stauffacher, Gerber & Maffluletti, 2010).

#### **O-10 Numerical rating scale**

The 0-10 Numeric Rating Scale (NRS) could be described as a segmented numeric version of the Visual Analog Scale (VAS) in which a respondent mention a number, from 0 to 10, which best depicts the intensity of his or her pain (Farrar, Young, LaMoreaux, Werth, & Poole, 2001).

Being a one-dimensional means to measure pain intensity in adults, the 0-10 NRS was recommended as a diagnostic tool by The National Initiative on Pain Control (NIPC) in 2006 to assist in assessing the severity and quality of pain experienced by patients.

Other instruments used to measure pain intensity are the Wong-Baker FACES Pain Rating Scale, the Visual Analog Scale and the Verbal Pain Intensity Scale (NIPC, 2006), but the 11-point NRS was used due to its merits.

The 11-point NRS is a patient's self-report instrument. It has the advantage of providing the most valid and measure of pain experience. Reported intra-examiner reliability coefficient of .98 has been recorded despite the fact that pain is subjective (De C Williams, Davies & Chadury, 2000). It is easy to administer and score, and does not require the use of a machine of any sort for assessment. It is also economical in terms of money and time wastage. Apart from the above, the minimal language translation problems support its use across cultures as a universal instrument.

An identified weakness of NRS is that, it evaluates only one (1) component of the pain experience; intensity, forgetting about the complexity and idiosyncratic nature of the pain experience or improvements due to symptom fluctuations (Hawker, Davis, French, Cibere, Jordan, & March, 2008).

### **Data Collection Procedures**

An application letter for an introduction letter (see Appendix E) was sent to the Head of the Department of Health, Physical Education and Recreation, University of Cape Coast. The introductory letter (see Appendix F) was sent to the Institutional Review Board of University of Cape Coast for ethical clearance. A letter captioned; ETHICAL CLEARANCE – ID; UCCIRB/CES/2017/26 (Appendix G) was received as an approval for the implementation of my research protocol. A letter of appreciation (see Appendix H) was again sent to the Institutional Review Board of University of Cape Coast for ethical clearance to express my sincere gratitude for the approval granted. Permission was also sorted from the Central Regional Coordinator of Physical Education (see

Appendix E) to study Central Region SHS athletes involved in the annual athletic championship.

A pilot study was carried out in the Greater Accra Region. The participants were SHS students who play handball and volleyball on weekends on the Fire Academy and Training School's sports facility. The pilot study exposed the researcher and the research assistants to the instruments used, the intervention procedure as well as ensuring proper calibration of the instrument.

The pilot study also helped both the researcher and the research assistants to be very familiar with the use of the instruments to measure pain and ROM. After the preparation of the data collection form copies were given to three experts in Sports Psychology, Health Education and Sports Science for validation. Their contributions led to changes in the format of the data collection form (see Appendix I), and reconstruction of questions 10-16. An arrangement was also made to meet the Head of the medical team for a briefing about the study and the expected role they were to play.

On the first day of the competition, the researcher and his two research assistants went to the field early to set up the grounds. A double room canopy was mounted at a designated area, under which a wooden 3-dimensional OMS room was assembled. A screened massage bed, three (3) tables, four (4) plastic chairs, six (6) packs of sachet water, a plastic bowl, a bottle of liquid soap, a cover sheet and six (6) napkins were also well arranged under the canopy.

The researcher had a short meeting with the medical team before the start of the competition, to refresh their minds about the study and the data collection

procedures. The type of injuries to be referred to the researcher was also discussed. The researcher and the research assistants took their position after the meeting, waiting for casualties. The sex, age, type of injury and school of any casualty referred to the researcher was recorded by one of the research assistants on a Data Collecting Form before the researcher took over the injured athlete.

Before working on any participant, a brief about the purpose of the study and the type of therapeutic modality to be used was given by the researcher, after which an informed consent form (Appendix J) was issued out to the participant by one of the research assistants for signing. The researcher took over again and asked the casualty to either relax on the massage bed or to sit on a chair, depending on the injured part of the body. The ROM of the neck and injured limbs were then measured by the researcher using the appropriate instrument.

The measured angles of motion in degrees were recorded by a research assistant as pre-test scores. The researcher introduced ERT with a gentle touch of the injured area with a finger. This was done as a means to assess the intensity of the pain of the injury. The participants were then requested to use the 0-10 NRS, as already informed, to measure the pain intensity. The figures mentioned were recorded as pre-test scores. The researcher followed up with series of finger pressure manipulations at the injured areas or pain points for some few minutes. Intermittent assessment of pain rates were done during rest periods in the finger pressure manipulations. For about 10 minutes or a maximum time of 30 minutes, the intervention came to an end with the final measurement of pain rate. The

responses from the participants were recorded by a research assistant, using the 0-10 NRS, as post-test scores.

The ROMs of the related joints of the injured body parts were measured again; after the intervention, and recorded as post-test scores. Three times post-test ROM measurements were carried out to ensure accuracy. At the end of the day's programme, the researcher refreshed the medical team and the research assistants. After the refreshment, the researcher and the two research assistants packed up and departed.

On the second day of the competition, the researcher and the research assistants arrived an hour earlier to set up the intervention stand before the start of the competition. The same routine of procedures used to apply the intervention to participants during the first day of the athletics competition was followed for data collection on the second day of the athletics competition.

### **Data Processing and Analysis**

In order to answer the research questions and hypotheses, the quantitative data collected were processed and analyzed using the SPSS computer analytical tool, version 20.00. Some of the nominal data were coded to enhance processing. Descriptive statistics such as frequency, percentages, medians, means and standard deviations were calculated for demographic characteristics, injuries and treatment modalities, as well as pain and ROM measurements (Pallant, 2011). The measured pre-test and post-test scores of pain intensity were ranked using interval scale as follows; 0-3(low), 4-7(average) and 8-10(high). Frequency and percentage scores were used to answer the research questions.



To answer research question 1:- What is the effect of ERT on pain as experienced by injured SHS athletes of Central region?, differences between the pre-test frequency and percentage scores for rate of pain and the post-test frequency and percentage scores for rate of pain were considered. The frequency and percentage scores of the physiological response after management of pain with ERT were also considered.

To answer research question 2:- What is the effect of ERT on ROM as experienced by injured SHS athletes of Central region?, pre-test and post-test ranges (minimum and maximum) of measured ROM were compared to ascertain whether the application of ERT improved ROM of injured joints. Participants were also asked to respond to two questions (Data Collection form) on whether they could move their injured joints, before and after the experience of the intervention. The responses were collected under three categories being; - Not at all, Slightly and Freely. Differences in frequency and percentage scores in their responses to the two questions were calculated to answer the question.

To answer research question 3:- How effective is ERT in the management of pain as experienced by injured SHS athletes of Central region? a question was asked (Data Collection form) to allow participants rate the effectiveness of ERT in the management of their pain. The rating responses were in three categories;- Not Good, Good and Very Good. Frequency and percentage scores were then used to answer the question. Mean difference between the pre-test and post-test pain rating scores were also calculated and used in answering the question.

To answer research question 4; - How effective is ERT in the improvement of ROM as experienced by injured SHS athletes of Central region? calculated mean difference in pre-test and post-test neck ROM scores, the mean difference between pre-test and post-test shoulder ROM scores, the mean difference between pre-test and post-test elbow ROM scores, the mean difference between pre-test and post-test hip ROM scores, the mean difference between pre-test and post-test knee ROM scores and the mean difference between pre-test and post-test ankle ROM scores were all considered.

For hypothesis 1 & 2 of the study, paired samples t-test was used to accept or reject the stated hypotheses. The dependent paired sample t-test analytical tool was used because the scores to be compared were derived from the same sampled participants. They were tested more than once. There was a pre-test measurement before the intervention, and a post-test measurement after ERT was used to manage injuries of the SHS athletes from Central Region (Lani, 2017).

Furthermore, the effect size of each paired samples t-test score which indicated a statistically significant difference was also calculated. According to Thompson (2006) and Volker, (2006), an effect size provides an unvarying degree of the strength or enormousness of an effect. This critical information is not provided by the *p*-value which tells researchers how confidence they can be that there is an effect.

Effect size also allows us to go beyond the simple question of whether an intervention works or not, to a higher thinking level of how well the intervention works in a variety of circumstances (Batterham & Hopkins, 2015). Calculated

effect size referred to as “Eta squared ( $\eta^2$ )” ranges from 0 to 1. Proposed guidelines for interpretation Eta squared values are: - 0.01= small effect, 0.06 = moderate effect and 0.14 = large effect (Coe, 2002: Kohn, 2017).

To be able to reject or accept hypothesis 3;- There will be no significant difference in the degree of pain reduction due to age, gender, years of participation in active sports, number of previous injuries and part of body injured, the multivariate ordered logistic regression analyses was used. The multivariate ordered logistic regression statistical technique was used because the differences in degrees of pain reduction were in an orderly form.

This technique allows for assessment of the contribution of each of the independent variables to the disparities in pain reduction reported by the participants. The differences of reported levels/degrees of pain before and after the application of ERT were estimated, and through the Stata's xtile function the estimated differences in reduction of pain were grouped orderly under three categories as shown in Table 1.

**Table 1:- Categories of pain reduction**

Difference/Degree of pain reduction (Grouped)	Category label	Frequency	Percent
1 – 6	A little reduction	17	27
7 – 9	Big reduction	31	50
10	Very big reduction	14	22
Total		62	100

The ordered and grouped level of pain reduction was then used as a response variable in ordered regression analyses with the assumption that there is a natural ordering of the levels (from “ a little” to “very big”), but the distances between adjacent levels are difficult to tell. The predictor variables used were age, gender, period of starting active sports, number of injuries prior to the current injury and the body part currently injured. Since the ordered logit model estimates one equation over all levels of the dependent variable, a concern is whether one-equation model is valid or a more flexible model is required. This hypothesis was tested with proportional odds test (Brant test of parallel regression assumption).

As shown in Table 2, the Brant test indicates that the parallel regression assumption is not violated. All the  $p$ - values are greater than 0.05, indicating that none of the independent variables violates the parallel regression assumption and hence the ordered logit model used was in order.

**Table 2:- Brant Test of Parallel Regression Assumption**

Variable	chi2	p>chi2	df
All	6.50	0.260	5
Agegrp	3.33	0.068	1
gender	3.11	0.078	1
exp	0.02	0.898	1
injurybf	0.33	0.565	1
bodyprtg	0.11	0.744	1

A significant test statistic provides evidence that the parallel regression assumption has been violated.

### **Summary**

The study was experimental in nature, and followed the quantitative research methodology. The one group pre-test post-test design was also employed. The study area was Cape Coast. The population for the study was 244 SHS athletes selected for Regional athletic championship.

The purposive sampling technique was employed. For data collection the following instruments were used: -, OMS, Standard goniometer and 0-10 NPRS. The necessary protocols and approvals needed before data collection were followed and secured from the Ethics Board of U.C.C. Graduate School, the Head of Department (HPER) and the Central Regional Physical Education Coordinator. A pre- test involving SHS students in Accra, as well as meeting with the Head of the medical team for the competition were also conducted before data collection. During the competition these three (3) instruments; OMS, a standard goniometer and 0-10 NRS were used to collect data on pain and ROM of injured subjects.

For the processing and analysis of the data, the SPSS computer analytical tool, version 20.00 and Stata version 14 were used. Frequency and percentages of the raw scores were calculated and used to answer the research questions. The dependent paired sample t-test and the multivariate ordered logistic regression analyses, at alpha level of 0.05 were also used to accept or reject the stated

hypotheses. Finally, the effect sizes of the revealed significant differences were considered.

## CHAPTER FOUR

### RESULTS AND DISCUSSION

The study was aimed at ascertaining the effect of ERT on pain and ROM of injured SHS athletes of Central region, Ghana. Senior High school athletes were selected from the second cycle level of the education system in Ghana. They are basically homogeneous in terms of age, educational background, school curriculum and learning experience. Their physical education tutors and coaches were also trained in the same University in Ghana; University of Cape Coast and University of Education, Winneba.

This chapter deals with the results and discussion of the findings in relation to the hypotheses and research questions of the study. The results of the analysis of the data collected by the use of the Data Collection Form, as well as other quantitative data analyses conducted to address the aim of the study are presented.

**Table 3:-Demographic Characteristics**

Characteristics	Frequency	Percent
Gender		
Male	38	61
Female	24	39
Age range		
16-19 years	36	58
20-23 years	26	42
N = 62		

Results from Table 3 shows a total number of 62 SHS athletes, made up of 38 males (61%) and 24 females (39%) who accidentally sustained injuries involving their lower and upper limbs, during the 2017 Schools and Colleges National Sports championship, were used as participants for the study. The higher frequency and percentage of male participants is an indication that more SHS male athletes from Central Region got injured during the sports festival than their female counterparts. This phenomenon goes against the findings of Ferber et al. (2007), Herber (2010), Sallis et al. (2001), Shmerling, (2015), Taunton et al. (2002) and Wick (2014) which indicated that females are more prone to sports injuries than males due to their anatomical and physiological make-up. The usual situation of males dominating sports contingents in terms of numbers, the vigorous and rough play which characterize most male games, presence of chronic injuries, and overstress or overuse of some athletes may account for the high rate of injuries among the male participants of Central Region. Wicks (2014) has also pointed it out that by understanding their unique risks when exercising, women can take precautions to prevent injuries.

Furthermore, the ages of the participants ranged between 16 years to 23years. The age range of 16-19 years was the mode (36) with the percentage of 58%. The participants within the age range of 20-23 years were 42%. This trend could be explained by the fact that most children in Ghana start primary school education at 6 years and should be in SHS by 16 to 19 years, however, various socio-economic reasons could be used to explain the delay in the school going age and the number of years a Ghanaian child spends in a school. Adelabu and



Oyelana (2016), and Merkel (2013) have explained that poverty, poor nutrition, truancy, lack of medical facilities and care, and the interest in playing sports than going to school are ugly factors which contribute to delays in school going age and the number of years students spent in schools.

**Table 4:-Participants from Various Central Region SHS**

Schools	Frequency	Percent (%)
Winneba SHS	9	14.5
Obrakyire SHS	8	12.9
St Augustine's College	8	12.9
Mfantsipim School	6	9.7
Adisadel College	6	9.7
Cape Coast Inter. Sch.	5	8.1
Ghana National College	4	6.4
Obiri Yeboah SHS	4	6.4
Wesley Girls SHS	4	6.4
Holy Child SHS	3	4.8
Apam SHS	2	3.3
Swedru SHS	2	3.3
Edinaman SHS	1	1.6
N	62	100

As already stated, all the participants were SHS students from 13 schools in the Central Region. Winneba SHS recorded 9 participants, being the highest frequency, representing 15%. Obrakyire SHS and St Augustine's College followed 8 (13%) participants each, with Edinaman SHS recording the least, being 1(2%). The high percentage recorded by Winneba SHS, St. Augustine's College and Obrakyere SHS, as shown in Table 4, could be due to the high

number of athletes selected from these schools due to their excellent performance during the 2017 Central Region schools and colleges super-zonal athletics Championship held at Adisadel College. Schools like Edinaman SHS, Swedru SHS, Apam SHS and others had only few selected athletes to compete for the region, hence the low recorded participants (Central Region Physical Education Directorate, 2017).

**Table 5:-Sports History of Participants**

Sports history	Frequency	Percent
Level of Education participants		
started playing sports.		
Primary School	19	30.6
JHS	32	51.6
SHS	11	17.7
Sports played before		
Football	19	25.3
Handball	16	21.3
Athletics	14	18.7
Volleyball	9	12.0
Basketball	4	5.3
Hockey	4	5.3
Table Tennis	3	4.0
N = 62		

With regard to the types of sports played before, Table 5 revealed that 25% of the subjects have played football before. This should not be a surprise when dealing with people from a country like Ghana where football is a passion and almost every school and community, whether in the urban or rural areas, has a

park or a field on which school children and the youth play football as a recreational or sports activity. Football is also among the popular games taught as a lesson during Physical Education (P.E.) classes, since the facility and equipment needed to teach this sport are not expensive, and are easily available (Central Region Physical Education Directorate, 2017).

Hockey and basketball recorded the same low percentage of 5%, with table tennis recording the least percentage (4.0) of participants. This might be due to the fact that hockey, basketball and table tennis are not popular games in Ghana (Central Region Physical Education Directorate, 2017). Even though the teaching and learning of hockey, basketball and table tennis are part of the P. E. syllabus for schools in Ghana, few popular and high graded schools in the cities have the facilities and equipment to teach and play them as a sport.

The high costs involved in the construction of a basketball court and a hall for table tennis, as well as the procurement of the equipment for the game of hockey might be the major reasons why most of the schools in Ghana fail in teaching and playing those games as a sport (Central Region Physical Education Directorate, 2017). Apart from the above, most parents and students have the perception that the game of hockey is risky and prone to injury, hence, the lack of interest in the game (Mair, 2014).

As shown in Table 5, 52% (32) of the participants started playing sports at Junior High School (JHS) level. The high percentage of the participants starting playing sports at JHS level might be due to the fact that the education curriculum in Ghana allows for competitive sports right from the primary school level. The

primary school athletes become skillful by the time they reach JHS to play for their school teams. Thirty-one percentage (31%) of the participants also started playing sports at the Primary School level. It is therefore not a surprise to have a low percentage (18%) for participants who started playing sports at SHS level.

**Table 6:-Injury History of Participants**

Characteristics	Frequency	Percent
Past injuries sustained		
Sprain	40	28.8
Muscle cramp	31	22.3
Strain	13	9.3
Shoulder Pain	13	9.3
Back Pain	12	8.6
Elbow pain	12	8.6
Waist pain	8	5.7
Dislocation	7	5.0
Fracture	2	1.4
Muscle tear	1	1.0
Treatments used for sports injuries		
Massage	39	23.1
Deep freeze	37	21.9
Ice	34	20.1
Bandage	22	13.0
Deep heat	18	10.7
ERT	16	9.4
Hospital	3	1.8

N =62

Among the injuries sustained by the participants, the most prevalent injuries as shown in Table 6, are sprain (29%) and muscle cramp (22%). Strain and shoulder pain were the third prevalent injuries (9%), back pain and elbow pain followed as the fourth prevalent injury with (9%). The fifth and sixth prevalent injuries were waist pain (6%) and dislocation (5%) respectively. Very serious injuries like fracture (1%) and muscle tear (1%) followed up to be the least prevalent injury sustained by the participants.

The above data is not a new trend in sports. Sprain has often been mentioned as the most prevalent injury among football (soccer) and basketball players (Jones, 2016). According to Prezi (2012), poor training methods, usage of inappropriate sports equipment and facilities, lack of physical conditioning and poor warm-up are the main causes of sprain and other sport injuries such as muscle cramp, strain, shoulder and back pains.

From the results, the commonest method of treatment used in the past by the participants to manage their injuries was massage (23%), followed by the use of deep freeze (22%), ice (20%), bandage (13%), deep heat (11%) ERT (9%) and going to hospital for the treatment of injuries surprisingly having the least patronage of 2%. When performed by trained therapists, massage could be seen as one of the effective therapies for the management of ankle or knee acute sprains (Pandy et al., 2007). Unfortunately, in our part of the world, trained physical therapist or masseurs are hard to come by. Most of the masseurs following sports teams of schools and colleges are quack self-trained masseurs who have interest in the profession or doing something to earn some income.

Another sad problem is that, the Physical Education Tutors and sports coaches of the SHS in Ghana, who also serve as Athletic Trainers, lack the knowledge and skills of massaging, application of deep freeze and ice. However, the introduction of a level 300 course titled; - Introduction to Sports Medicine, by the Department of Health, Physical Education and Recreation, of the University of Cape Coast, since 2006 has exposed and equipped some students with an appreciable knowledge and skills of massaging which are not sustained by regular practice. The revelation from Table 6 indicating the use of massage, deep freeze and ice as the most used methods of treatment of past injuries, justifies the fact that most athletes are carriers of chronic ankle and knee sprain (Cunha, 2017; Mock, Abantanga, Cummings & Koepsell, 1999; MedicineNet, 2016; Spine-health, 2017; Young, 2017).

**Table 7:- Body Part Injured**

Body part	Frequency	Percent
Knee	17	27.4
Ankle	16	25.8
Thigh	10	16.1
Elbow	7	11.3
Hip	7	11.3
Calf	4	6.5
Shoulder	3	4.8
Wrist	1	1.6
Waist	1	1.6
N=62		

According to Table 7, the most injured body part during the championship was the knee, with the frequency of 17 representing 27%. This was followed by 16 participants (26%) reporting injuries of the ankle. Apart from the above, 10 (16%), 7 (11%) and another 7 (11%) of the participants reported thigh, elbow and hip injuries respectively. There were also 4 (7%) calf injuries, 3 (5%) shoulder injuries, and 1(2%) each of wrist and waist injuries reported.

The picture painted by Table 7 is a direct reflection of that of Table 6 which has sprain as the leading reported injury. As already mentioned, ankle and knee sprain stand tall among other sports injuries among Ghanaian young athletes because of overuse of the few talented and very good athletes in schools, weakness in muscles, tendons and ligaments, lack of rest for worked out muscles to recover, unsafe exercising environment, poor training methods, usage of inappropriate facilities and equipment, poor warm-up and poor nutrition (Heidloff, 2013; Mair, 2017; Prezi, 2012). It is also a general knowledge that, for fear of not being selected for a competition or a match, most school level athletes hide their injuries and force to train with them to impress coaches.

Most of the methods used to treat past injuries of the participants were not professionally applied, and injuries were not also taken to the hospital (Table 6), most of their injuries ended up to be chronic and re-occurred in subsequent games using the same parts of the body injured (Tuzun, 2007). It is therefore not a surprise to have the ankle and knee as the most injured parts of the body.

**Research Question 1: What is the Effect of ERT on Pain as Experienced by Injured SHS Athletes of Central Region?**

The aim of research question 1 was to ascertain the impact of ERT on pain. To be more precise, the answer to research question 1 revealed whether ERT can reduce the intensity of traumatic pain or can relief traumatic pain. Table 8 was considered in answering the question at hand.

**Table 8:- Effect of ERT on Pain**

Rate of pain (NRS)	Frequency	Percent
Rate of pain before ERT		
5.00	2	3.2
6.00	4	6.5
7.00	6	9.7
8.00	14	22.6
9.00	10	16.1
10.00	26	41.9
Rate of pain after ERT		
.00	31	50.0
1.00	16	25.8
2.00	3	4.8
3.00	4	6.5
4.00	1	1.6
5.00	3	4.8
6.00	1	1.6
7.00	1	1.6
8.00	1	1.6
10.00	1	1.6

N=62

Table 8 revealed the frequency and percentage of rates of pain participants reported before the application of the intervention (ERT) and after the application of the intervention.

A close analysis of pain rates before the application of the intervention (ERT) and after the application of the intervention, as indicated in Table 8, was



hereby needed to answer Research Question 1. Before the intervention, as much as 42% (26) of the participants reported of severe pain (10 on the NRS), but after the intervention as many as 50% (31) of the participants reported no pain (0 on the NRS) followed by 39% (24) of the participants who reported feeling less than moderate pain (5 on NRS). Only 2% (1) of the participants reported of severe pain (10 on the NRS).

Table 8 also revealed that, before the intervention, a cumulative huge percentage of 100 (62) of the participants reported pain rates ranging from 5 (moderate pain, using the NRS) to 10 (severe pain, using NRS) as against a small cumulative percentage of 11.2 (7) participants who reported pain rate ranging from 5 (moderate pain, using the NRS) to 10 (severe pain, using the NRS) after the intervention. Apart from the above comparative indications, 50% (31) of the participants also reported No Pain (0 on NRS) after ERT was used to manage their pain. Apart from the above comparative analysis of the descriptive statistics presented in Table 8, the response of the participants to a question (Data Collection form) on how they felt after the management of their pains with ERT, indicated in Table 9 was also considered in answering research question 1.

**Table 9:-Physiological response after Management of pain with ERT**

Response	Frequency	Percent
Not Relieved	7	11.3
Relieved	29	46.8
Very Relieved	26	41.9
Total	62	100

Table 9 indicated that a total of 55 (89%) participants felt relieved from pain and restricted ROM which are major signs and symptoms of the injuries they sustained. Out of the total of 89%, about half; 42% (26) reported feeling Very Relieved. Only 7 (11%) participants reported feeling Not Relieved after the management of their injuries with ERT.

Result revealed that ERT is an effective treatment therapy in relieving traumatic pain and improving restricted ROM. This finding buttresses the proposition that a simple act of touching, used in therapies like massage, acupuncture, reflexology and others, is so powerful that it can increase levels of endorphins to reduce pain which is usually the cause of restricted ROM (Body Ecology, 2017; Carty, 2006; Dobson, 2006; Fitzakerley, 2014; Huffington, 2014; Narins, 2014; Stoppler & Shiel, 2014). Accordingly to the Gate Control theory, activities of descending fibres originating from the supraspinal regions and projecting to the dorsal horn could also close the gate, thus blocking pain signals at the spinal cord level, to reduce pain perception by the brain (Basbaum, 2011). Mukherjere (2017) has mentioned that endorphins are released to provide long-term relief from pain and ailments, anytime pressure points on the body are stimulated. Guthrie (2014) has also revealed that, the brain oozes endorphins to muffle pain signals in response to a gentle but firm touch on a pressure point. Another support to the finding is Dacher's (2013) postulation which says that a massage after a day's workout is necessary for the body to release endorphins, cortisol and oxytocin to help prevent muscle soreness, and to manage pain. Touch in the form of massage or pressure increases beta waves (brain waves),

endorphins, dopamine, serotonin and oxytocin to induce deep sleep to reduce fatigue and pain (Borrelli, 2016; Dobson, 2006; Gala, 2004; Smith, 2015). The Gate Control theory also indicates that, the brain stem neurons are part of the endogenous analgesic system which are capable in releasing endogenous opioids. The released endogenous opioids like beta-endorphins, enkephalins, and dynorphins, collectively known as endorphins, act on opioid receptors. When endorphins act on opioid receptors which are located at the nerve endings of both primary afferent (sensory) nerve and the projector interneuron, they block neurotransmission of pain signals (Biological Sciences, 2017, Carroll, 2016; Wlassoff, 2014).

**Research Question 2: What is the Effect of ERT on ROM as Experienced by Injured SHS Athletes of Central Region?**

This research question tried to find out the effect of ERT on the ability of participants to move the joints of injured body parts to their maximum ROM. In order to ascertain the effect of ERT on ROM, pre-test and post-test ranges (minimum and maximum) of measured ROMs were compared. The minimum pre-test ROM of the neck turned to the right was 50, and 75 to the left. The post-test minimum measurements of 85 and 80 ROM to the right and left respectively indicated an improvement in ROM due to the intervention. The maximum pre-test and post-test scores were 90 respectively. For elbow ROM, the pre-test minimum score of 93 improved to a post-test minimum score of 107 after the intervention. The improvement revealed could be attributed to the effect of ERT which was the intervention. There were also improvements in the ROM of the knee and ankle joints after the application of the intervention. Minimum knee

ROM of 20 and maximum ROM of 170 changed to 108 and 180 respectively. The ROM of injured ankle joints also revealed that, the pre-test maximum score of 40 improved to post-test maximum score of 45 after the intervention (ERT). The responses to item number 12 (Data Collection Form);- Were you able to move the joint of your injured limb?, and item number 14;- Can you move your joint after being treated?, on the data collection form, were also used to ascertain the effect of ERT on ROM.

**Table 10:-Movement of Injured Limb**

Movement	Frequency	Percent
Movement before ERT		
Not at all	3	5
Slightly	52	84
Freely	7	11
Movement after ERT		
Slightly	22	36
Freely	40	65

N = 62

Statistical figures in Table 10 indicated that, as much as 52 (84%) of the participants were able to move their injured limb slightly while as low as seven (7) participants (11%) also could freely move their injured limb before the intervention. However, three (3) participants (5%) could not move their injured limb at all. After the management of the injuries of the participants with ERT, those who could move their limbs freely increased from 7 (11%) to 40 (65%). The number of participants who could move their limbs slightly: 52 (84%) also decreased to 22 (36%) participants, indicating more than 50% improvement.

After the intervention, no participant indicated of not being able to move the limb at all.

As a conclusion and an answer to research question 2, the findings suggested that ERT improves ROM of joints. As supports to the findings, postulations by Bell (2008), Carty (2006), Dobson (2006) and Davis, (2011) will be considered. According to them, the release of hormones like serotonin, dopamine and endorphins during the act of touching and massaging increases levels of anti-inflammatory cytokines and decreases levels of inflammatory cytokines. Inflamed soft tissues of the body also start reducing gradually along with the pain reduction (Fitzakerley, 2014; Gala, 2004). The accompanied sedative effect of ERT also helps in the relaxation of stressed tight muscles, ligaments and tendons at joints to improve flexibility and ROM (Huffington, 2014, Narins, 2014; Stoppler & Shiel, 2014).

**Research Question 3: How Effective is ERT in the Management of Pain among Injured SHS Athletes of Central Region?**

**Table 11:-Effectiveness of ERT**

Rating	Frequency	Percent
Not Good	0	0.00
Good	19	30.6
Very Good	43	69.4
Total	62	100.0

Table 11 revealed the response of the participants to a question on how they would rate ERT in terms of effectiveness in pain management. As many as 43 participants (69%) rated ERT to be very good, while 19 (31%) reported that the

ERT is a good intervention for the management of pain. Cumulatively, 62 (100%) participants rated ERT very high in terms of effectiveness.

**Table 12:-Mean difference between the pre-test and post-test rates of pain.**

Period	Mean	Std. Deviation
Before therapy	8.68	1.44
After therapy	1.36	2.18

N = 62

From Table 12 it was clear that before the management of the pain with ERT, the mean pain rate of the 62 participants was as high as 8.68 (SD = 1.44) on the 11-point NRS used. This high mean pain rate is considered to be almost severe pain on the 11-point NRS. As indicated in Table 10, the mean pain rate of 8.68 (SD = 1.44) decreased to a mean pain rate of 1.36 (SD = 2.18), after the use of ERT to manage the pain of the participants. This revealed a very significant mean pain rate reduction (mean difference) of 7.32. On the 11-Point NRS used, a pain rate of 1.36 is considered as very mild pain level just above 0 pain rate (“No pain” on the 11-point NRS).

The high rating of ERT revealed by Table 11 and the reduction in mean pain rate from 8.68 to 1.36 shown by Table 12 are indications that ERT is very effective in the management of pain.

Contemporary literature also supports the effectiveness of ERT. According to Carty (2006) ERT works by stimulating the nervous system for the release of the body’s natural healing chemicals - endorphins. Endorphins are natural pain relieving chemicals (neuropeptides) possessing morphine-like effects (Graham,

2006; Sprouse-Blum, Smith, Sugai, & Parsa, 2010). It has also been revealed that endorphins interact with the opiate receptors in the brain to reduce perception of pain, just as drugs like morphine and codeine. Apart from the reduction of pain, other notable physiological benefits such as the feelings of euphoria, modulation of appetite, enhancement of the immune response and the feeling of fewer negative effects of stress are experienced when endorphins are released (Narins, 2014; Stoppler & Shiel, 2014).

Another empirical support for the effectiveness of ERT in the management of pain is the postulations of the Gate Control theory. According to the theory, the central nervous system has the ability to block pain signals at the spinal cord level in a descending order. As part of the endogenous analgesic system are brain stem neurons which release endogenous opioids like  $\beta$ -endorphins, enkephalins and dynorphins, collectively known as endorphins, to act on opioid receptors. Opioid receptors are located at the nerve endings of both primary afferent (sensory) nerve and the projector interneuron to block neurotransmission of pain signals (Biological Sciences, 2017; Carroll, 2016; Wlassoff, 2014).

It is also interesting to note that, the A-beta ( $A\beta$ ) fibre as explained by the Gate Control theory is myelinated but transmits non-painful stimuli like rubbing, touch, pressure, temperature and vibration used in massaging, ERT and other physical therapies to block the perception of pain (Moayedi & Davis, 2013).

**Research Question 4: How Effective is ERT in the Improvement of Range of Motion of Injured SHS Athletes in Central Region?**

To be able to answer the above stated question, the various mean differences between the pre-test and post-test ROMs, as in the following tables: - Tables 13, 14,15,16,17 and 18 were considered.

**Table 13:-Mean difference in pre-test and post-test neck Range of Motion**

Rotation	Mean	Std. Deviation
Left;- Before ERT	87.69°	4.03°
After ERT	89.61°	1.80°
Right;- Before ERT	87.75°	5.73°
After ERT	89.79 °	.92°

N=62

According to Table 13, the mean ROM of the neck of the 62 participants during rotation to the left, before ERT, was 87.69° (SD =4.03°). The mean neck rotation ROM increased to 89.61° (SD=1.80°) after ERT. A mean improvement of 1.93° was recorded to indicate the positive effect of ERT on ROM. A mean neck ROM improvement of 2.04° was also recorded with the rotation to the right. Before the therapy, the mean neck ROM was 87.75°. After the intervention with ERT, the mean neck ROM increased to 89.79°. That was another positive sign of the effectiveness of ERT.



**Table 14:-Mean difference between pre-test and post-test shoulder Range of Motion**

Movement	Mean	Std. Deviation
Abduction;- Before ERT	88.00°	43.56°
After ERT	146.67 °	25.17°
Adduction;- Before ERT	5.00°	.43°
After ERT	23.66°	1.92°

N = 3

From Table 14, the mean abducted shoulder ROM of the injured shoulder before ERT was 88.00° (SD =43.58°). The mean shoulder ROM increased to 146.67° (SD=25.17°) after ERT. A mean improvement of 58.67° was recorded to indicate the positive effect of ERT on ROM.

During shoulder adduction, a mean shoulder ROM improvement of 18.67° was also recorded. Before the therapy, the mean shoulder ROM was 5.00° (SD = .43°). After management with ERT, the shoulder ROM increased to 23.67° (SD= 1.92°). The result is an indication of the effectiveness of ERT in the management of restricted ROM.

**Table 15:-Mean difference in pre-test and post-test of elbow Range of Motion**

Movement	Mean	Std. Deviation
Flexion;- Before ERT	109.86°	8.04°
After ERT	146.86 °	3.53°
Extension;- Before ERT	172.29°	.72°
After ERT	179.00°	1.92°

N = 7

With reference to Table 15, the effectiveness of ERT was also revealed by the mean differences of elbow ROM before and after the intervention. The mean elbow ROM of flexed injured elbows before ERT was 109.86° (SD = 23.28°), after ERT, the mean elbow ROM of flexed injured elbow improved to 146.86° (SD = 23.28°). With the injured elbows, 172.29° (SD = 9.34°) was recorded as the mean extended elbow ROM before ERT. However an improved mean extended elbow ROM of 179.00° (SD = 1.92°) was recorded after ERT.

**Table 16:-Mean difference between pre-test and post-test hip Range of Motion**

Movement	Mean	Std. Deviation
Flexion;- Before ERT	60.43°	42.79°
After ERT	129.43°	28.41°
Extension;- Before ERT	63.43°	84.44°
After ERT	66.29°	85.01°

N = 7

In Table 16, the mean ROM of the flexed hip of the participants before ERT, was 60.43° (SD =42.79°). The mean hip ROM increased to 129.43° (SD=28.41°) after ERT. A mean hip ROM improvement of 69.00° was recorded to indicate the positive effect of ERT on ROM. A mean hip ROM improvement of 2.86° was also recorded with hip extension. Before the therapy, the mean hip ROM was 63.43° (SD = 84.44°). After the intervention with ERT, the mean hip ROM increased to 66.29° (85.01°). This is another indication of the effectiveness of ERT as an injury management modality.

**Table 17:-Mean difference between pre-test and post-test knee Range of Motion**

Movement	Mean	Std. Deviation
Flexion;- Before ERT	90.70°	43.78°
After ERT	149.26°	13.89°
Extension;- Before ERT	163.11°	36.38°
After ERT	169.67°	35.61°

N = 27

In reference to Table 17, the effectiveness of ERT was also revealed by the mean differences in knee ROM before and after the intervention. The mean knee ROM of flexed injured knee before ERT was 90.70° (SD = 43.78°), after ERT, the mean knee ROM of flexed injured knee improved to 149.26° (SD = 13.89°). With the injured knees, 163.11° (SD = 36.38°) was recorded as the mean knee ROM (extension) before ERT. However an improved mean knee ROM of 169.67° (SD = 35.61°) was recorded after management of injury with ERT.

**Table 18:-Mean difference between pre-test and post-test ankle Range of Motion**

Movement	Mean	Std. Deviation
Plantar flexion;- Before ERT	14.20°	29.19°
After ERT	29.05°	19.43°
Dorsi-flexion;- Before ERT	9.00°	10.68°
After ERT	12.50°	7.42°

N = 20

The trend seems to be the same indicating improvement in mean ROM during plantar-flexion and dorsiflexion of the injured ankle. Before ERT the

mean ankle ROM of plantar flexion was  $14.20^{\circ}$  (SD =  $29.19^{\circ}$ ) but improved to  $29.05^{\circ}$  (SD =  $19.43^{\circ}$ ) after the intervention. In the case of dorsiflexion, before ERT mean ankle ROM improved from  $9.00^{\circ}$  (SD =  $10.68^{\circ}$ ) to  $12.50^{\circ}$  (SD =  $7.42^{\circ}$ ) after ERT.

From the above premise on the mean ankle ROM, the revelations have really confirmed that ERT is very effective in the management of ROM. Existing literature of experts like Bell (2008), Carty (2006), Dobson (2006) and Davis, (2011) confirm the release of hormones like serotonin, dopamine and endorphins during the act of touching and massaging increases levels of anti-inflammatory cytokines and decreases levels of inflammatory cytokines to help improve ROM.

According to Fitzakerley (2014) and Gala (2004), inflamed soft tissues of the body also start reducing gradually along with the pain reduction caused by released endorphins during physical therapy sessions. They also made it clear that, the accompanied sedative effect of ERT also helps in the relaxation of stressed tight muscles, ligaments and tendons at joints to improve flexibility and ROM. From the evidences in Tables 13, 14, 15, 16, 17 and 18, the simple answer to research question 4 is that ERT is very effective in the improvement of ROM.

For the test of the hypotheses the paired-samples t-test was conducted for significant differences between the pre-test and post-test results of pain and ROM of injured Central Region SHS athletes.

**Hypothesis 1: There will be no Significant Difference in Pain after ERT is used to Manage Injuries of SHS Athletes of Central Region.**

To answer hypothesis 1, difference between the mean pain intensity before ERT and the mean pain intensity after ERT was ascertained using a paired-sample t-test.

**Table 19:-Paired-samples t-test results for significant difference in pain before and after using ERT to manage pain.**

Mean	SD	t	df	$\eta^2$	Sig. (2-tailed)
7.32	2.52	22.87	61	.90	.00

P < 0.05

The analysis as in Table 19 revealed a significant difference between the pre-test and post-test paired mean pain intensities. The paired sample t-test results indicated a paired mean difference of 7.32, standard deviation of 2.52,  $t(61) = 22.87$  and .00 significant level. With the alpha level set at 0.05, hypothesis 1 was rejected. The eta squared value ( $\eta^2 = .90$ ) exhibited a large effect in the magnitude of pain reduction. This revealed that ERT was very effective in the management of pain of injured SHS athletes of Central Region of Ghana.

The results have confirmed the postulations of Carty (2006), Fitzakerley (2014) and Gala (2004) which indicate that ERT, acupressure and transcutaneous electrical nerve stimulation (TENS) are all non-invasive and inexpensive pain management approaches used for acute and chronic traumatic pains. Guthrie (2014), Highland (2017) and Johnson (2017) have also revealed that, by the stimulation of pressure points with a touch, endorphins are released to muffle pain signals. Confirmations from Mukherjere (2017) and Chen (2017) supports

the fact that stimulating pressure points relaxes muscular tension by releasing endorphins which provide long-term relief from ailments and pains.

The findings of Coan (2006), Dacher (2013), Dobson, (2006) and Huffington (2014) which postulated that, touch leads to the release of dopamine, endorphins, melatonin, oxytocin and serotonin to relief pain and to promote good feelings and wellbeing, could also be cited as support to the rejection of hypothesis 1.

**Hypothesis 2: There will be no Significant Difference in ROM after ERT is used to Manage Injuries of SHS Athletes of Central Region.**

Paired- sample t-test results for significant differences in the neck, shoulder, elbow, hip, knee and ankle ROM before and after using ERT to manage injuries of SHS athletes of Central Region, were considered to answer hypothesis 2.

**Table 20: Paired-samples t-test results for significant difference in neck, shoulder and elbow ROM before and after using ERT.**

	Mean	SD	t	df	$\eta^2$	Sig.(2-tailed)
Neck left rotation	-1.93°	3.45°	-4.40	61	.24	.00
Neck right rotation	-2.04°	5.12°	-3.14	61	.14	.00
Shoulder abduction	-58.67°	36.50°	-2.78	2	.11	.11
Shoulder adduction	-34.00°	57.17°	-1.03	2	.02	.41
Elbow flexion	-37.00°	21.86°	-4.48	6	.25	.00
Elbow extension	-6.71°	7.68°	-2.32	6	.08	.06

P< 0.05

According to the statistical indications in Table 20, for the rotation of the neck to the left, there was a paired mean difference of -1.93°, standard deviation

of  $3.45^\circ$ ,  $t(61) = -4.40$  and  $.00$  significant level. With the alpha level set at  $0.05$ , a significant difference in neck ROM was realized. Hypothesis 2 was rejected. With the large effect size ( $\eta^2 = .24$ ), it was concluded that the extent of improvement was vast. There was also an indication of significant difference in neck ROM with the rotation of the neck to the right ( $M = -2.04^\circ$ ,  $SD = 5.12^\circ$ );  $t(61) = -3.14$ , and  $p < 0.05$ . Hypothesis 2 was again rejected. The large effect ( $\eta^2 = .14$ ) also indicated a vast degree of improvement in ROM. These results suggested that ERT was very effective in the management of restricted neck ROM of the participants; the magnitude of effect was enormous.

Table 20 also indicates that there was no significant difference in the two paired means of shoulder abduction ROM ( $M = -58.67^\circ$ ,  $SD = 36.50^\circ$ );  $t(2) = -2.78$  and  $p > 0.05$ . The eta squared value ( $\eta^2 = .11$ ) indicated an almost large effect of ERT. For shoulder adduction ROM, there was also no significant difference in the two paired means ( $M = 34.00^\circ$ ,  $SD = 57.17^\circ$ );  $t(2) = -1.03$  and  $p > 0.05$ . The paired-samples t-test results failed to reject hypothesis 2.

The small effect size ( $\eta^2 = .02$ ) and the small number of participants ( $N = 3$ ) who reported of shoulder injury might be the reasons for the failure to reject hypothesis 2. According to Deziel (2017), Faber, (2014) and Marley, (2014), a too small sample size increases the margin of error and can render the research meaningless. Table 20 again, revealed a significant difference in the two paired means of elbow flexion ROM ( $M = -37.00^\circ$ ,  $SD = 21.86^\circ$ );  $t(6) = -4.48$  and  $p < 0.05$ . With a large effect size ( $\eta^2 = .25$ ) it was clear that ERT was very effective. On the other hand, the independent paired-sample t-test results showed no

significant difference in the two paired means of elbow extension ROM ( $M = -6.71^\circ$ ,  $SD = 7.68^\circ$ );  $t(6) = -2.32$  and  $p > 0.05$ , but the effect size ( $\eta^2 = .08$ ) was above moderate effect.

The no significant difference in the two paired means of elbow extension ROM indicated by the independent paired sample t-test results could be explained by the fact that, the elbow joint normally moves in one plain. When injured, the elbow joint may be bent slightly due to pain, preventing full extension.

**Table 21:-Paired-samples t-test results for significant difference in hip, knee and ankle ROM before and after using ERT to manage injury.**

	Mean	SD	t	df	$\eta^2$	Sig.(2-tailed)
Hip flexion	-69.00°	47.27°	-3.86	6	.20	.01
Hip extension	-2.86°	4.26°	-1.78	6	.02	.13
Knee flexion	-58.56°	40.41°	-7.53	26	.48	.0
Knee extension	-6.56°	8.85°	-3.85	26	.20	.00
Ankle flexion	-8.35°	9.12°	-4.09	19	.22	.00
Ankle extension	-20.05°	14.04°	-6.39	19	.40	.00

$P < 0.05$

Table 21 indicated that there was a significant difference in the two paired means of hip flexion ROM ( $M = -69.00^\circ$ ,  $SD = 47.27^\circ$ );  $t(6) = -3.86$  and  $p < 0.05$ . The effect size ( $\eta^2 = .20$ ) of ERT was very large. For hip extension ROM, there was also no statistical significant difference in the two paired means ( $M = -2.86^\circ$ ,  $SD = 4.26^\circ$ );  $t(6) = -1.78$  and  $p > 0.05$ . Apart from the small effect size ( $\eta^2 = .02$ ), the anatomical structure of the hip joint naturally restricts the backward



movement (extension) of the hip, hence the effect of ERT on ROM will not be significantly observed after the management of the injury.

Table 21 also revealed a significant difference in the two paired means of knee flexion ROM ( $M = -58.56^\circ$ ,  $SD = 40.41^\circ$ );  $t(26) = -7.53$  and  $p < 0.05$ . This was buttressed with a huge effect size ( $\eta^2 = .48$ ). The paired-sample t-test results also indicated a statistically significant difference in the two paired means of knee extension ROM ( $M = -6.56^\circ$ ,  $SD = 8.85^\circ$ );  $t(26) = -3.85$  and  $p < 0.05$ . The large effect size ( $\eta^2 = .20$ ) flagged that ERT was very operative. The paired-samples t-test results rejected hypothesis 2 again.

Apart from the above results, Table 21 divulged results indicating a significant difference in the two paired means of ankle flexion ROM ( $M = -8.35^\circ$ ,  $SD = 9.12^\circ$ );  $t(19) = -4.09$  and  $p < 0.05$ . The effect size ( $\eta^2 = .22$ ) was large. The independent paired-sample t-test results also confirmed a significant difference in the two paired means of ankle extension ROM ( $M = -20.05^\circ$ ,  $SD = 14.04^\circ$ );  $t(19) = -6.39$  and  $p < 0.05$ . The results were again propped by the huge effect size ( $\eta^2 = .40$ ) of ERT.

From the analyses of the independent paired-sample t-test results revealed in Tables 20 and 21, it could be stated as an answer to hypothesis 2 that, there was a significant difference in ROM after ERT was used to manage injuries of SHS athletes of Central Region. This answer rejects hypothesis 2 of the study which states that, there will be no significant difference in ROM after ERT is used to manage injuries of SHS athletes of Central Region. The statistical results suggest that ERT is an effective therapy for the management of restricted ROM of joints.

The postulation of Hargrove (2008) could be cited here as a support to this finding. According to him, as a protective mechanism, the central nervous system is alerted to stiffen muscles when in pain. The release of endorphins suppresses the protective mechanism of muscle stiffness to improve ROM.

The findings of Bell (2008), Carty (2006) and Davis (2011) confirm that released endorphins, dopamine and serotonin during the act of touching and massaging, decrease levels of inflammatory cytokines to help improve ROM. It has also been revealed that, inflamed soft tissues of the body reduce gradually along with the pain reduction caused by released endorphins during physical therapy sessions (Fitzakerley, 2014 & Gala, 2004).

**Hypothesis 3: There will be no significant difference in the degree of pain reduction due to age, gender, educational level of starting active sports and part of body injured.**

From the paired T-test analysis and effect size estimation, it is clear that ERT has significant effect on reducing pain and improving motion. What were not accounted for were the differences in the degree of reduction of pain among the athletes. In other words, why was it that some reported a 10 degree of pain reduction (10 points of pain to 0), while others only reported less degrees of reduction? The multivariate ordered logistic regression analysis was used to explain the disparities in pain reduction, and to reject the null hypothesis.

**Table 22:- Ordered logit model estimating factors influencing the magnitude of change between before and after application of endorphin release therapy**

							No. obs. = 62
							LR Chi2(9) = 40.73
							Prob.>chi2 = 0.000
							Pseudo R2 = 0.317
	Category	Odd ratio	Std. Error	Sig.	95% Confi. Interval		
Age group	16 -19	1.000					
	20+ years	0.104	0.080	0.003	0.023	0.465	
Gender	Female	1.000					
	Male	1.559	1.145	0.545	0.360	6.580	
Started sports	Primary	1.000					
	JHS	0.105	0.077	0.002	0.025	0.442	
	SHS	0.536	0.460	0.468	0.100	2.882	
No. of previous injuries		0.721	0.217	0.277	0.400	1.301	
Parts of body injured	Other parts	1.000					
	Ankle	1.240	1.047	0.799	0.237	6.490	
	Elbow	0.065	0.094	0.059	0.004	1.111	
	Knee	1.252	1.179	0.812	0.198	7.929	
	Thigh	0.092	0.097	0.024	0.012	0.729	
	/cut 1	-3.324	1.171		-5.620	-1.023	
	/cut 2	-1.548	1.104		-3.712	0.615	

The results from the model are given in Table 22. A one unit increase in age of athlete leads to the odds of “very big” reduction versus the combined “a little” and “big” pain reduction categories of about 0.104 times less, given that the other variables are held constant in the model.

Another statistically significant predictor is the period during which the athlete started active sports. A unit increase in starting active sports in JHS leads to 0.105 times lower in odds of having higher levels of pain reduction compared to those who started from primary school. Also compared to other parts of the body, the odds of having higher levels of pain reduction for those who get thigh injuries is about 0.092 times lower.

Sustaining elbow injuries also seems to have some significant lower odds in having higher levels of pain reduction after the application of ERT. More injuries in the pasts also have lower odds in higher levels of pain reduction, though not significant. On the other hand, ankle and knee injuries have higher odds of 1.240 and 1.252 respectively, indicating that ankle and knee injuries seem to lead to higher levels of pain reduction, though these were not statistically significant.

The results from the ordered logit model revealed that there were significant differences in the Odd ratios of the independent variables. The null hypothesis was therefore rejected. The results suggest that older athletes and those who started active sports from JHS are found to be more likely to report lesser reductions in pain after the application of ERT. Perhaps this could be attributed to the fact that ageing is accompanied with some physiological changes.

According to Gambert (2008), Morley (2018) and Vitelli (2014), the metabolism of some hormones of the body slows down. This affects the function of some vital organs and glands. The pituitary gland gradually reduces in size and in the production of endorphins after middle age. Cohen et al. (2012) have revealed that muscles decrease in number and shrink in size as we age.

Generation of new muscle fibres is slower in older people. There is also insufficient use of oxygen, stiffness of soft tissues and slow recovery from injury. These factors may lead to a longer experience of pain in older people (Minson, 2015).

Scientific evidence also shows that, the wear and tear of tissues during competitive sports can lead to lifelong damage in youth who start too young (DiFiori, 2014). The problem of overused injuries becoming chronic and difficult to manage is also more serious among those who have longer years of participation in active sports (Maffulli, 2005; Rogers, 2009). Injuries of athletes who did not start playing competitive sports early do not often become overused and chronic, therefore they heal at a faster rate (Kraemer, 2009; Tillye, 2012).

The finding that males are more likely to have big reduction in pain than their female counterparts could be buttressed by the postulation of Kempen, Sanderman, Scarf-Klomp and Ormel (2009) which says that males recover faster than females. Research findings of Ferber et al. (2007); Herber (2010); Sallis et al.(2001); Shmerling (2015); Taunton et al. (2002) and Wick (2014) have also revealed that females are more susceptible to sports injuries than males because of their anatomical and physiological make-up.

Hormonal difference in gender has also been identified as a vital factor when considering differences in injury recovery rates. Testosterone is known to promote protein synthesis which is critical for the development of larger muscles, muscle repair and growth in men (Byer, 2016; Putukian, 2012; Sipski, Jackson, Gomez-Marin, Restores & Stein, 2004).

## Key Findings

In the attempt to answer the research questions and research hypotheses, the following statistical revelations came out. The answer to research question 1 (What is the effect of ERT on pain of injured SHS athletes?) was that, ERT is very effective in relieving pain of injured SHS athletes.

An answer to research question 2 (What is the effect of ERT on ROM of joints of injured SHS athletes) was that, ERT improves ROM of joints of injured SHS athletes. For research question 3 (How effective is ERT in the management of pain of injured SHS athletes?), the answer was that ERT is very effective in the management of pain of injured SHS athletes.

From the evidences in Tables 13, 14, 15, 16, 17 and 18, the answer to research question 4 (How effective is ERT in the improvement of ROM of joints of injured SHS athletes?) was that ERT is very effective in the improvement of ROM of joints of injured SHS athletes. Research hypothesis 1, which stated that there will be no significant difference in pain after ERT is used to manage injuries of SHS athletes of Central Region, was rejected since the paired-sample t-test results revealed a significant difference between the two paired mean pain intensities.

After analyzing the independent paired-sample t-test results shown in Tables 20 and 21, that research hypothesis 2, which stated that there will be no significant difference in ROM after ERT is used to manage injuries of SHS athletes of Central Region, was also rejected. The statistical results suggest that

ERT is an effective therapy for the management of restricted ROM of joints of injured SHS athletes.

The results from the ordered logit model revealed that there were significant differences in the Odd ratios of the independent variables. The results explain the disparities in the rates of recovery from pain among the SHS athletes from Central Region, Ghana. Null hypothesis 3 was therefore rejected.

## CHAPTER FIVE

### SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

#### Summary

This chapter dealt with the summary of the write-up and the conclusion of the study. It went further to suggest recommendations which could be used to improve the scope of the use of ERT as a cheap and effective therapeutic modality for the management of traumatic pain and the improvement of ROM of injured joints of the body. However a brief synopsis of the purpose of the study, research questions and research hypotheses which directed the study, research methods and the analytical tools employed were restated. Furthermore, a summary of the findings of the study by research questions and research hypotheses were also highlighted.

The study was carried out purposefully to ascertain the effect of ERT on musculo-skeletal pain and ROM of injured SHS athletes in the Central Region of Ghana. Senior High School (SHS) athletes are selected from the second cycle level of the education system in Ghana. As already stated, they are basically a homogenous target population in terms of age, educational background, school curriculum and teaching and learning experiences.

Apart from the aim, outcomes of the study were to scientifically establish the effectiveness of ERT in the management of sports injuries, to have baseline data to support the use of ERT, and to promote and include ERT to the existing therapies for the improvement of ROM and the relief of traumatic pains of injuries sustained during playing of sports.



As an experimental study, the quantitative research methodology and the pre-test post-test design were employed. A purposive non-probability convenient sampling technique was also used to sample 62 participants out of 244 selected SHS athletes of Central Region. Instruments used were ERT, OMS, a standard goniometer, and 0-10 NRS. The collected data were processed and analyzed using the SPSS analytical tool, version 20.00. The calculated frequencies and percentages were used to answer the research questions of the study. To be able to respond appropriately to the hypotheses of the study, the paired sample t-test, at alpha level of 0.05, was used to establish significant differences in pre-test and post-test measurements of pain and ROM of injured SHS athletes after the use of ERT. Apart from establishing significant differences, the effect sizes of the mean differences were also considered during the discussions.

The answer to research question 1 (What is the effect of ERT on pain of injured SHS athletes?) was that, ERT is very effective in relieving pain of injured SHS athletes. For research question 2 (What is the effect of ERT on ROM of joints of injured SHS athletes?), the answer was that, ERT improves ROM of joints of injured SHS athletes. For research question 3 (How effective is ERT in the management of pain of injured SHS athletes?), the answer was that ERT is very effective in the management of pain of injured SHS athletes. The answer to research question 4 (How effective is ERT in the improvement of ROM of joints of injured SHS athletes?) was that, ERT is very effective in the improvement of ROM of joints of injured SHS athletes. The research hypotheses 1 and 2 were rejected since the paired-sample t-test results revealed significant differences

between the two paired mean pain and ROM respectively. The statistical results suggested that ERT is an effective therapy for the management of pain and restricted ROM of joints of injured SHS athletes of Central Region, Ghana.

The null hypothesis 3 was also rejected. Results revealed by the ordered logit model indicated significant differences in the Odd ratios of the independent variables. The results explained disparities in the rates of recovery from injuries (pain) among the SHS athletes from Central Region, Ghana, due to the effect of the independent variables ( age, gender, years in participation in active sports and part of body injured).

### **Conclusions**

The results of the study confirmed the findings and results of studies carried out by experts in physical therapy that, a touch is so powerful that it can increase levels of endorphins to reduce pain ( Body Ecology, 2017; Carty, 2006; Dobson, 2006; Fitzakerley, 2014; Gala, 2004; Huffington, 2014; Narins, 2014; Stoppler & Shiel, 2014). The results also confirmed that the release of hormones like serotonin, dopamine and endorphins during the act of touching and massaging increases levels of anti-inflammatory cytokines and decreases levels of inflammatory cytokines to reduce pain (Bell, 2008; Davis, 2011; Dobson, 2006; Fitzakerley, 2014; Gala, 2004).

Apart from the above, the results of the study recognized the fact that the accompanied sedative effect of ERT also helps in the relaxation of stressed tight muscles, ligaments and tendons at joints to improve flexibility and ROM (Huffington, 2014; Narins 2014; Stoppler & Shiel, 2014).

An unexpected but a new insight revealed by the study was the higher percentage (61%) of males reporting injuries during the sports festival. The revelation defied research findings of Ferber et al. (2007), Herber (2010), Sallis et al. (2001), Shmerling (2015), Taunton et al. (2002) and Wick (2014) which indicated that women are more prone to sports injuries due to factors among which are their high estrogen level and less muscle strength. However, Wicks (2014) has concluded that by understanding their unique risks when exercising, women can take reasonable measures to avoid injury. This might explain why less of the SHS female athletes of the Central Region contingent reported injuries (Table 1).

The results of the study have exhibited that ERT is an effective physical therapy. With the consideration of effect size, ERT also proved to be every effective in the management of pain than ROM. The disparities in degrees of recovery from pain among the participants have also been explained.

### **Recommendations**

1. Based on the results, it is recommended that Central Region Schools and Colleges Sports Federation should adopt ERT as a main method of managing sports injuries.
2. Health facilities, sports therapist and first-aiders in Central Region should also adopt ERT since they are all involved in managing sports injuries.
3. The Department of Health Physical Education and Recreation should consider introducing ERT in their curriculum for the training of their students.

### **Suggestions for Further Research**

Future research work on the efficacy of ERT is recommended to cover athletes in the tertiary institutions and the national team.

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**APPENDICES**

**APPENDIX A**

**APPRECIATION LETTER FROM DR. HENRY PUFAA**

My Gratitude to Ben Korsah

I was involved in a terrible motor accident that rendered me half paralysed downwards. In fact a lot of people took me for dead even after my spinal operation. Thanks to Ben for his well administered endorphin release therapy technology, today, I trot and play badminton. Ben, thank you.

Dr. Henry Augustine Pufaa  
University of Education  
Winneba, Ghana.

APPENDIX B

LETTER OF APPRECIATION FROM DR. B.L. BOATENG

THERAPEUTIC TESTIMONY ON BEHALF OF MR. BEN KORSAH,  
(A certified Endorphine Release Therapist)

In the year 2004, I underwent a surgical operation at the University of Cape Coast Hospital for the removal of my septic gall bladder. A few months after the successful surgery I began to experience some unusual muscular dystrophy which did not respond to normal medical treatment.

Mr. Ben Korsah who was then my student reading for a Master's Degree at the Department of Health Physical Education and Recreation recommended a treatment called Endorphine Release Therapy which he had learned from an expatriate NGO woman from Ireland to whom he had been an assistant.

He applied the treatment once a week for a period of 3 months and "lo and behold" the dystrophied muscles bounced back to normality. The NGO lady observing the progress of this gentleman in the therapy recommended Mr. Ben Korsah to the originator of this new therapy and arranged for a year's course with him in Ireland. While on the course in Ireland he displayed mastery of the technique to the amazement of his colleagues.

He returned to Ghana with a certificate of completion of the course and started assisting the Sports Section of the University of Cape Coast in accelerated treatment of sports-related injuries of students, in addition to other ailments.



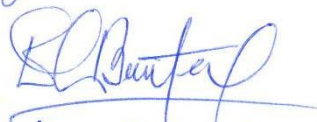
3

The Department of Health, Physical Education and Recreation of the University of Cape Coast recognizing the efficacy of the therapy invited Mr. Ben Korsah to <sup>establish</sup> a course of learning for students of the department. During the yearly University Open Day exhibitions he has demonstrated instant treatment of people with neck problems.

He accompanies university sports teams on competition trips and positively applies this therapy to injured sportsmen and women to the amazement of qualified medical personnel.

I have heard of several testimonies from aged people who have been relieved of their aging health problems. Some clients have been saved from near paralysis in parts of the body.

Finally, I bear this testimony because I feel and I have experienced that the therapy works and I recommend Mr. Ben Korsah to anyone who feels the need for joint, muscular and nervous treatment through this amazing therapy.



Dr. B. L. Boateng

Lecturer, Dept. of HPER, UCC. Dec. 2004.

**APPENDIX C**

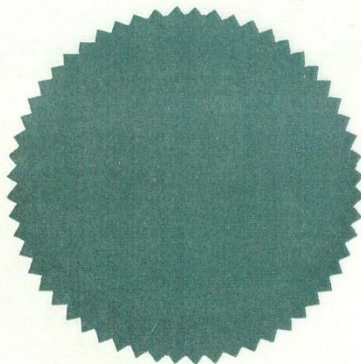
**ORTHOPEDIC MOBILITY SCANNER PATENT RIGHT (IRELAND)**



**Certificate of Grant of a Patent**

**PATENTS ACT, 1992**

It is hereby certified that a patent bearing the specification No. S83578 has been granted to  
JOHN CARTY, an Irish Citizen, 83 Knocklyon Road, Templeogue, Dublin 16, Ireland  
in respect of an invention entitled A measurement apparatus which invention was the subject of an  
application for that patent under Part III of the Act having a filing date of 14/04/2004.



Dated this 24th day of August, 2004

**Controller of Patents, Designs and  
Trade Marks.**

APPENDIX D

ORTHOPEDIC MOBILITY SCANNER PATENT RIGHT (U.K)

	<h1>Certificate of Grant of Patent</h1>
<p>Patent Number: GB2401681 Proprietor(s): John Carty Inventor(s): John Carty</p>	
<p><i>This is to Certify that, in accordance with the Patents Act 1977,</i> a Patent has been granted to the proprietor(s) for an invention entitled "<b>A measurement apparatus</b>" disclosed in an application filed <b>14 April 2004</b>.</p>	
<p>Dated 31 May 2006</p>	
	 <p><b>Ron Marchant</b> <i>Comptroller General of Patents, Designs and Trade Marks</i> UNITED KINGDOM PATENT OFFICE</p>
<p>The attention of the proprietor(s) is drawn to the important notes overleaf.</p>	

**APPENDIX E**

**APPLICATION FOR INTRODUCTORY LETTER**

UNIVERSITY OF CAPE COAST  
P. O. BOX UC 5  
CAPE COAST  
CENTRAL REGION

12<sup>TH</sup> JULY, 2017

THE HEAD OF DEPARTMENT  
HEAD OF PHYSICAL EDUCATION &  
RECREATION DEPARTMENT  
CAPE COAST  
CENTRAL REGION

Dear Sir,

**APPLICATION FOR INTRODUCTORY LETTER**

I am a PhD Student of Health Physical Education & Recreation (HPER) Department with Registration No. ED/PE.D/15/0003.

I have gone through the required Thesis update procedure and cleared to collect data for my Thesis titled "The Effect of Endorphin Release Therapy on Pain and Range of Motion of Injured S.H.S. Athletes in Central Region, Ghana".

By this letter, I wish to apply for an Introductory Letter to enable me meet the requirement for Ethical Clearance and to introduce me to anybody whose assistance I may need to carry out my data collection.

Thank you.

Yours faithfully,



**BERNARD KORSAH**

**APPENDIX F**

**INTRODUCTORY LETTER**

**UNIVERSITY OF CAPE COAST**  
**CAPE COAST, GHANA**  
**COLLEGE OF EDUCATION STUDIES**  
**FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION**  
*Department of Health, Physical Education & Recreation*

**TELEPHONE: 233-0206610931, 0543021384, 0268392819**

**TELEX: 2552, UCC, GH.**

Cables & Telegrams:  
UNIVERSITY, CAPE COAST



Ref. No. ED/PED/15/0003/5

13<sup>th</sup> July, 2017

The Chairman,  
Institutional Review Board  
University of Cape Coast  
Cape Coast

**INTRODUCTORY LETTER – MR KORSAH BERNARD (ED/PED/15/0003)**

The bearer of this letter is an PhD student of the above department. In partial fulfilment of the requirements for the programme. he is conducting a study on the topic **“The Effect of Endorphin Release Therapy on Pain and Range of Motion of Injured S.H.S. Athletes in Central Region, Ghana”** and would need ethical clearance from your outfit.

We would therefore be most grateful if assistance could be offered to him to carry out the research.

We count on your co-operation.

Thank you.

A handwritten signature in blue ink, appearing to read 'Charles Domfeh', written over a circular stamp or seal.

Dr. Charles Domfeh  
**HEAD**

APPENDIX G

LETTER FROM IRB-UCC

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 03321-33172/3 / 0207355653/ 0244207814

C/O Directorate of Research, Innovation and Consultancy

E-MAIL: irb@ucc.edu.gh

OUR REF: UCC/IRB/A/2016/178

YOUR REF:

OMB NO: 0990-0279

IORG #: IORG0009096



31<sup>ST</sup> OCTOBER, 2017

Mr. Bernard Korsah  
Department of Health, Physical Education and Recreation  
University of Cape Coast

Dear Mr. Korsah,

**ETHICAL CLEARANCE –ID :(UCCIRB/CES/2017/26)**

The University of Cape Coast Institutional Review Board (UCCIRB) has granted **Provisional Approval** for the implementation of your research protocol titled '*The Effect of Endorphin Release Therapy on Pain and Range of Motion of Injured SHS Athletes in Central Region, Ghana*'. This approval requires that you submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

Please note that any modification of the project must be submitted to the UCCIRB for review and approval before its implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

A handwritten signature in blue ink, appearing to read 'S. Asiedu Owusu'.

Dr. Samuel Asiedu Owusu  
Administrator

ADMINISTRATOR  
INSTITUTIONAL REVIEW BOARD  
UNIVERSITY OF CAPE COAST  
Date: 31/10/2017

**APPENDIX H**

**LETTER OF APPRECIATION**

**DR SAMUEL ASIEDU OWUSU  
INSTITUTIONAL REVIEW BOARD  
ADMINISTRATOR  
UNIVERSITY OF CAPE COAST.**

17<sup>th</sup> NOVEMBER, 2017

Dear Sir,

RE-ETHICAL CLEARANCE-ID: (UCCIRB/CES/2017/26)

Reference to your letter dated 31<sup>st</sup> October, 2017 with the above caption.  
I write to express my sincere gratitude for granting me a provisional Approval for the implementation of my research protocol titled '*The Effect of Endorphin Release Therapy on Pain and Range of Motion of Injured SHS Athletes in Central Region, Ghana*'.

I promise to follow all conditions prescribed.

Thank You.



MR BERNARD KORSAH

## APPENDIX I

**DATA COLLECTION FORM**

This Data Collection Form is strictly for a PhD Research on effectiveness of Endorphin Release Therapy on Pain and Range of Motion. Every information will be treated confidentially. Participation is voluntary.

**Instruction: - Please tick (✓) the correct response.**

**SECTION A: Demographic Information**

1. Age range:  12 – 15yrs  16 – 19yrs  20yrs and above
2. Gender:  Male  Female
3. Name of School: \_\_\_\_\_
4. Sports played  Football  Basket Ball  Handball  Table Tennis  
 Netball  Volley Ball  Athletics  Hockey
5. Level you started playing Sports:  Primary School  J.H.S  S.H.S

**SECTION B(1): Sports Injuries Profile**

6. Types of Sports injuries sustained before:  Sprain  Strain  Muscle Pull  
 Muscle Tear  Waist Pain  Dislocation  Fracture  
 Elbow Pain  Shoulder Pains  Back Pains  
Others (specify): \_\_\_\_\_
7. Therapy used to treat the injury:  Deep Heat  Deep Freeze  Bandaged  
 Massage  Ice  Endorphin Release Therapy (ERT)  Hospital  
Others (specify): \_\_\_\_\_

**SECTION B(2): Current Injury**

8. Part of body injured:  Neck  Head  Shoulder  Elbow  
 Wrist  Finger  Back  Waist  Hip  Groin  
 Thigh  Knee  Calf  Shin  Ankle  Toe  
Others (specify) \_\_\_\_\_

**SECTION C: Pain**

**Instruction:-**Please circle the number that represents your pain level, ranging from 0 (no pain) to



- 10 worst pain) for Item No. 9 and 13.
9. Level of Pain of today's Injury:  
 0 1 2 3 4 5 6 7 8 9 10  
 No pain Worst pain
10. Are you able to turn the neck fully after the injury?  Yes  No
11. If no, how do you feel in the neck?  Slightly Stiff  Stiff  Very Stiff
12. Were you able to move the joint of the injured limb?  Not at all  
 Slightly  Freely
13. Level of Pain after Therapy:  
 0 1 2 3 4 5 6 7 8 9 10  
 No pain Worst pain
14. Can you move the joint after being treated?  Not at all   
 Slightly Freely
15. How do you feel after treatment? (Please state) \_\_\_\_\_
16. How would you rate the Therapy? (Please state) \_\_\_\_\_

**SECTION D: Range of Motion**

17.

Joint Of Body Part Injured	Before Treatment	After Treatment
Neck		
Shoulder		
Elbow		
Wrist		
Hip		
Knee		
Ankle		
Fingers		
Toes		

APPENDIX J

**UNIVERSITY OF CAPE COAST**

**INSTITUTIONAL REVIEW BOARD**

**INFORMED CONSENT FORM**

**Title:** Effect of Endorphin Release Therapy on Pain and Range of Motion of injured SHS Athletes in the Central Region, Ghana

**Principal Investigator:** BERNARD KORSAH (ED/PED/15/003)

**Address:** University of Cape Coast, Department of Health Physical Education and Recreation. Cape Coast

**General Information about Research**

The purpose of this Study is to ascertain the effect of Endorphin Release Therapy on Musculo-Skeletal pain and Range of Motion (ROM) of injured SHS athletes in Central Region, Ghana.

The study is experimental and it will deal with the use of a natural physical therapy; Endorphin Release Therapy, to manage pain and restricted range of motion of joints of SHS athletes who will get injured during the 2017 Central Region Super Zonal Athletic Competition.

Other instruments to be used are the goniometer, which will be used to measure the range of motion at your injured limb, the 11 point numerical pain rating scale, which will be used to measure the level of pain of your injury and the Orthopedic Mobility Scanner which will be used to measure the range of motion in your neck.

When you are injured, the first aiders will carry you to the Medical Base located at a corner of the Stadium. You will be received warmly by the Medical Team. Your injury will be assessed and the following procedures will be followed:

You will be asked to show and say something about your injury. The range of motion of your neck will be measured first with the orthopedic Mobility Scanner. The range of motion of the joint of your injured part of body will also be

measured with a goniometer and finally, the pain level of your injury will be measured with a 11 point numerical pain rating scale. Endorphin Release Therapy will be used to manage your pain after which the pain level and joint range of motions will be measured again be recorded. Every information will be kept confidential.

### **Procedures**

To find answers to some of these questions, we invite you to take part in this research project. If you accept, you will be required to report at the Medical Base where a Research Assistant will receive you. A verbal interaction will follow to know your problem. A consent form will be given to you to fill. If you agree to be part of the study, pre-text measurement of range of motion and pain intensity of your injury will be made. Endorphin Release Therapy will be used to manage your injury after which post-text measurement of range of motion and pain intensity will be made. The nature of your injury will determine the duration of the management.

You have been selected to be used in this study because; your injury is the type which could be managed to produce the expected result or information for the study.

### **Possible Risks and Discomforts**

(It is possible for participants to feel some bearable pain. However, Endorphin Release Therapy will be used to reduce the pain.)

### **Possible Benefits**

(Pain will be reduced as well as an improvement in the range of motion of the joints of injured part of the body.)

### **Alternatives to Participation**

Application of ice to reduce pain and stretching to improve range of motion of joints.

### **Confidentiality**

I will protect every information about you. The place will also be screened to give privacy.

### **Compensation**

Water and soft drinks will be provided for rehydration and refreshment.

### **Additional Cost**

There will be no additional cost.

### **Voluntary Participation and Right to Leave the Research**

Participation in this research is voluntary and you have the liberty to refuse been treated with Endorphin Release Therapy without any consequences.

### **Termination of Participation by the Researcher**

If participant is very sensitive to touch, intolerance to pain or shyness, he/she may be removed from participation

### **Notification of Significant New Findings**

Participants will be informed about any significant new findings

### **Contacts for Additional Information**

For any further information, you may contact my Principal Supervisor, Prof. Dominic Fumulago, Department of Health, Physical Education and Recreation on her mobile phone number 0560083921 or at her office. I could also be contacted on my mobile phone number 0243402656.

### **Your rights as a Participant**

This research has been reviewed and approved by the Institutional Review Board of University of Cape Coast (UCCIRB). If you have any questions about your rights as a research participant you can contact the Administrator at the IRB Office between the hours of 8:00 am and 4:30 p.m. through the phones lines 0332133172 and 0244207814 or email address: [irb@ucc.edu.gh](mailto:irb@ucc.edu.gh).

## VOLUNTEER AGREEMENT

The above document describing the benefits, risks and procedures for the research title “Effect of Endorphin Release Therapy on Pain and Range of Motion of injured SHS Athletes in the Central Region, Ghana” has been read and explained to me. I have been given an opportunity to have any questions about the research answered to my satisfaction. I agree to participate as a volunteer.

---

Date

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Name and signature or mark of volunteer