CHAPTER III

Research is a logical and intensive process of carrying on the scientific method of analysis, in which methodology is the guideline system for solving a problem. It is a method of investigation that uses both informal and systematic observational approaches. The study's research methodology outlines the researcher's overall strategy for collecting answers to the research questions and informs readers about the study's approach. Its broad purpose is to investigate, describe, and verify empirical correlations and scientific hypotheses. (Millio and Diessenhaus, 1972).

It is necessary to prepare and construct a study based on the nature of the chosen problem as well as the venture's objectives and goals in order to conduct research.

The research methodology of specific research indicates not only the research method but also shows the logic behind the method adopted for the study (Kumar & Bhattacharyya, 2003). Research methodology, according to Rajasekar, philomination, and Chinnathambi (2013), is "a science of analyzing how research needs to be carried out and providing a systematic manner to solve the research problem." It seeks to give the research work plan by exhibiting how researchers go about their work of describing, explaining, or interpreting phenomenon.

The present work was pertaining to the cadaveric study on knee joint. This chapter explains the rationale of the study, research objectives, research hypotheses, research design, and sampling technique adopted for the study, materials and instruments used, its administration and measurement, and the ethical issues followed in the research.

3.1 Rationale of the study

Different disorders can damage the knee joint. In both developed and developing countries, osteoarthritis is the most frequent type of arthritis. It primarily affects the elderly and is a leading cause of disability among the aged worldwide. According to the World Health Organization, symptomatic osteoarthritis affects 9.6% of men and 18.0% of women over the age of 60 worldwide. 80 percent of people with osteoarthritis have movement limitations, and 25% are unable to conduct their major daily activities.

Musculoskeletal diseases affect 1.71 billion people worldwide, according to the Global Burden of Disease report. People all around the world are affected by musculoskeletal problems, despite the fact that the prevalence varies depending on age and diagnosis. 441 million people are anticipated to be affected in high-income nations, followed by 427 million in the WHO Western Pacific Region and 369 million in the WHO Southeast Asia Region. Around 149 million people worldwide are disabled owing to musculoskeletal problems, accounting for over 17% of all disabled people. Low back pain, fractures (436 million individuals worldwide), osteoarthritis (343 million), various injuries (305 million), neck discomfort (222 million), amputations (175 million) are all contributors to the overall burden of musculoskeletal diseases and rheumatoid arthritis (14 million).

Although people of all ages are at risk for musculoskeletal disorders, younger people have recently become more susceptible, especially during their peak earning years. Knee pain is the most common reason people quit their jobs early. Early retirement has a huge societal impact in terms of direct health-care expenses and indirect work absenteeism or productivity loss. Knee problems are also strongly linked to major mental health impairment. According to projections, the number of persons suffering from knee discomfort will rise in the future, and at a faster rate over the world. Furthermore, the globe is focusing on improving musculoskeletal rehabilitation services in countries and identifying enablers and hurdles to taking the global rehabilitation agenda ahead.

Failure of the medical treatment for severely damaged knee by arthritis or any injury, and may requires surgical interventions. In the last decade, knee procedures have transformed the surgical care of knees. In 1968, the first knee replacement operation was conducted. Improvements in surgical materials and methods have vastly improved its effectiveness since then. Total knee replacements are one of medicine's most successful treatments. More than 754,000 knee replacements were performed in the United States in 2017, according to the Agency for Healthcare Research and Quality.

Direct measurement of the articular surfaces of the lower end of the femur and upper end of the tibia in a cadaver in order to record specific morphometric characteristics of the femoral condyles is significant for engineering femoral & tibial component hemi-arthroplasty or total knee arthroplasty. The morphometric data of ligaments will play crucial role in selecting the quantity of graft for surgical repair of damaged ligaments during its reconstruction. As a nutshell, the goal of this research is to establish anatomical knowledge of the knee joint that will aid in major therapeutic implications.

Furthermore, in addition various orthopedic and anatomical studies have reported to be done on the articular surfaces and ligaments of knee joint but the present study will give the detailed knowledge of knee joint including with cadaveric analysis of articular surfaces, morphometric measurements of ligaments of joint, cadaveric relationship of various ligaments with its attachment and their inter relations which can significantly establish its importance in clinical implications. Purpose of present study is to find out the various measurements for the proper understanding of the individual structures and the attachment landmarks of each anatomical structures of joint as its fundamental knowledge is the prime point in complex diagnostic procedures and in various surgeries of knee joint, which will allow to make more appropriate and more functional outcomes in post-surgery. Additionally, Anatomic repairs, reconstructions of complex ligamentous injuries, and its rehabilitation programmed is one of the most prevalent among athletes. Present study will open up a new line for orthopedic surgeons and for radiologists. Awareness might help to the surgeons, sports physicians & physiotherapists in identifying and treating injuries of knee joint. Therefore, need of the present study is not only to confirm the previous findings on the knee joint, but to establish the enrich literature of knee joint.

Because menisci strains in a slightly flexed knee and Cruciate ligaments are one of the most common sites of injury in sports, forceful hyperextension of the knee, or anterior dislocation of the tibia, the menisci of the knee joint have gained special prominence. In posterior dislocation of the tibia, the posterior cruciate ligament is damaged. The injury could be anything from a sprain to a total tear. Rupture of the ligaments can lead to anomalous antero-posterior instability of knee joint. Surgical repair of the collateral and cruciate ligaments, menisci re-construction and other ligament reconstructions are fairly common surgeries in knee, usually with good to excellent outcomes in today's era.

Proper understanding of the individual structures and the attachment sites of each anatomical structure of knee joint and its fundamental knowledge is the prime point of complex surgeries of knee joint which will allows to make more appropriate and more functional results post-surgery & will aid in the planning of essential interventions in a variety of pathological and degenerative knee issues

3.2 Significance of the study

The human knee remains a masterpiece of design. Since humans alone enjoy a habitually upright posture, the joints have evolved fairly very rapidly to accommodate the bipedalism for locomotion and have likely contributed to triumphant success as a species so far. Our knees are very essential for us to live our everyday lives and to be mobile. They enable us to stand, walk, run, kneel, sit, cross-legged sit, drive, squat, work, dance, etc., and thereby to achieve all our essential activities of daily living and playful, joyful activities as well.

The knee joint is one of the largest and most intricate synovial joints of the body. It joins the femur, the body's longest bone, to the tibia. As a result, it is under the pressure all day while standing, walking, running, sitting, and performing different other activities. However, as the human lifespan extended, the flaws in the knee design emerged.

Structurally, the joint is less stable than the hip joint, and it is also far more restricted in motion. The knee can move forward and backward with a very limited amount of twisting motion permitted. The moment, the knee is no longer aligned with the foot; it relies strongly on the ligaments and muscles surroundings to it for its stability.

The knee is one of the most commonly injured body components, despite its extended lifespan. Furthermore, the joint is more sensitive to injury and disease than other joints since it joins the two longest bones, resulting in tremendous pressure on both sides. Common issues involving the knee include ligament injuries, strains, bursitis, fractures, torn meniscus, patellar tendinitis, overuse injuries, dislocation and many more. In addition, conditions like osteoarthritis, osteoporosis, and other medical complications are also significantly prevalent. In the concrete, Knee osteoarthritis is estimated to be the major cause of disability globally in the elderly population.

The knee is one of the most commonly affected joints in a variety of pathological and degenerative conditions that afflict people all over the world. Knee injuries are usually caused by a direct blow or a twisting or bending force exerted to the knee, such as from falls, accidents, or sporting activities. Due to an increase in the number of people who participate in physical activities, both professionally and recreationally, musculoskeletal injuries have dramatically grown in sports practices, particularly on the knees. Knee injuries account for 41% of all sports-related injuries. The anterior cruciate ligament is involved in one-fifth of them. Meniscus tears, posterior cruciate ligament tears, articular cartilage injury, bruising, muscle injuries, tendinopathy, and ligament and tendon avulsion are among the other injuries.

The risk factors for knee injury include internal as well external. The internal risk factors are age, gender, BMI, level of fitness, joint instability, poor muscle strength, foot alignment, foot-body- control-coordination, having osteoporosis, previous injuries, lack of recovery, post-injury rehabilitation, and stress. Overuse, incorrect or erroneous training, and participation in high-impact sports involving abrupt changes in direction are all external risk factors. Training intensity, playing surface condition, position played, exercise load, equipment quality, sports type (contact/non-contact, high/low velocity), exposure length, and level of competitiveness are all factors to consider. Furthermore, given the rising prevalence of obesity, modern lifestyles, and population ageing, knee discomfort and symptomatic knee osteoarthritis are expected to rise significantly globally over the next two decades.

Knee injury prognosis is usually determined by the nature and degree of the injury, as well as the necessity for physical therapy or surgery. The relevance of clinical assessment and evaluation cannot be overstated. Patient history, physical examination, inspection, correct knee injury diagnosis, clinical assessment, and appropriate investigations are all necessary. Pain, swelling, difficulty walking, and difficulty doing daily activities are all common symptoms of knee injury.

Returning to general health and fitness requires early diagnosis, adequate treatment, and an enhanced rehabilitation regimen. Conservative and surgical therapy options are available for knee injuries. The PRICE strategy, which involves protection, rest, immobilization, compression bandaging, and elevation, is a conservative therapy option. Analgesics are the drug of choice. Exercises, electrotherapy modalities, knee braces, sports taping, and ergonomics are all examples of physiotherapy that can help speed up recovery. Arthroscopic evaluation and treatment of individual pathologies are part of operational management.

Total joint replacement surgery, for extensive damage to the joint and in crippling state in degenerative knee osteoarthritis, enables exceptional rehabilitation in the life of an affected individual. As the prevalence of knee discomfort increases, so does the need for knee replacement surgery, commonly known as knee arthroplasty. The current increase in knee replacements has been attributed to age and obesity. The size of the implant plays a significant role in the functionality of a knee arthroplasty. Mismatch will be minimized and clinical results will be improved by selecting geometrically matched prostheses and appropriate implants based on ethnic requirements.

A disproportional patellofemoral joint implant would result in poor lever support, motion restriction, excessive wear, and patella instability, as well as knee pain. As a result, the morphometric dimensions of bones involved in the formation of the knee joint are frequently used in implant design and certain surgical procedures like patellar resurfacing for total knee arthroplasty and the harvesting technique of patellar implant graft during anterior cruciate ligament reconstruction.

The morphometric anatomy of the distal femur is critical for total joint replacement prosthesis design and internal fixation material. The shape of the femoral condyles and the intercondylar notch play a big role in the stability of the knee joint. In knee replacement surgery, distal femur fractures, insufficient bone stock, or poor bone quality, the distal femoral replacement prosthesis is suggested. Misalignment of the prosthesis might result in problems such as implant loosening or soft tissue impingement. As a result, the knowledge is frequently used to avoid harm to ligaments, blood vessels, nerves, and joints when placing intramedullary nails, plates, screws, and pins.

The condylar and intercondylar areas of the upper end of the tibia can be used to guide treatment and monitor the outcome of total knee replacement procedures. Information is crucial since it allows for a more accurate assessment of knee deformity. Knowledge is also useful in the unicompartmental arthroplasty procedure, which has recently emerged as a promising treatment option for older patients with unicompartmental arthritis of the knee, most usually involving the medial compartment. Because osteoarthritis of the knee normally affects the medial compartment of the tibiofemoral joint before spreading to the lateral compartment, this is true. The proper design of the prosthesis is critical for the correction of varus and valgus abnormalities of the knee during knee arthroplasty, as well as for providing the best possible results.

Meniscus injuries are widespread in both everyday life and sports. Increased weight and a sedentary lifestyle have been linked to meniscus injury and subsequent osteoarthritis. Meniscal morphometry is a useful anatomical knowledge for diagnostic and therapeutic methods. Advanced orthopedic arthroscopic surgeries, knee-transplant surgery, meniscal repair, meniscal transplant surgery, meniscectomy, meniscus allograft transplantation, and other procedures require it. The typical meniscus varieties are uncommon and often asymptomatic, though discoid menisci are more likely to tear. However, it is critical to recognize these variations since they can be mistaken for more serious abnormalities on MRI.

During anterior tibial translation and internal rotation, the anterior cruciate ligament acts as a key stabilizer. The ACL is the most often injured knee ligament, accounting for half of all knee injuries. Cruciate ligaments are particularly vulnerable to injury during sports activities, and sports workers are at risk of injury. Reconstruction surgeries for injured ligaments require morphometric knowledge of the quantity and quality of graft in surgical reconstruction of cruciate ligaments.

The functional importance of anatomical structures on the medial aspect of the knee, such as the Sartorius, Gracilis, Semitendinosus, and tibial collateral ligament, as well as their interrelationships and relationships to osseous structures, is useful in anatomical repairs and reconstructions of posttraumatic complex ligamentous injuries involving the medial and posteromedial knee structures. Knee surgeons and radiologists need a better understanding of the medial section of the knee for diagnostic and therapeutic purposes, as well as to improve their interpretation of injuries to the soft-tissue structures in this area.

Furthermore, the structures of the pes anserinus on the medial side of the knee have clinical significance and are a common injury location. Preoperative radiographic assessment of Pes anserinus may be beneficial to operating surgeons in avoiding complications during procedures such as transplant surgeries and graft harvesting during reconstructive surgeries. The information is useful for orthopaedic and plastic surgeons since the gracilis and semitendinosus tendons are regularly removed for anterior cruciate ligament tendon reconstruction.

The gold standard for complete posttraumatic assessment of the knee joint is currently magnetic resonance imaging. A thorough understanding of the anterior intermeniscal (or transverse) ligament architecture can help in arthroscopic evaluation, surgical repair, and meniscal allograft reconstruction, especially when identifying the varied attachment patterns of the anterior horn of the medial meniscus. Understanding these patterns is important for avoiding patient harm during surgical operations, especially arthroscopic ACL reconstructions, which are done close to the anterior intermeniscal ligament of the knee. As a result, surgeons benefit greatly from anatomical understanding of the intermeniscal ligament.

Looking at our knee; it goes through every day an enormous pressure, wear and tear stress. However, prevention is better than cure and therefore, knee injuries can be prevented and maintaining a healthy weight to avoid exerting more pressure on your knee joints is essential. Consequently, the usefulness of the anatomy of bones involving in formation of knee joint and the role of ligaments and other structures of knee in the mechanical design of knee has been a subject of interest to the researchers. With the present study author will aids in proper understanding and fundamental knowledge which is the prime in complex diagnostic procedures, joint replacement procedures and in various other surgeries of knee joint in current scenario.

3.3 Scope of the study

The scope of the study is multifold. The conclusions of the study would help the surgeons that treat the physically ill, in a great many ways. Since the study evaluates their understanding and practices relating to physical knee disorder, it can give them better clarity and the understanding of the true causes and nature of physical illness and thereby, increase the effectiveness of their long-established methods in collaboration with modern techniques of treatment. The study may also be helpful to physical health professionals such as general surgeons, orthopedic surgeons, plastic surgeons, physical therapists, and prosthetics and orthotics to understand the role of anatomical knowledge of knee joints in the physical well-being. Furthermore, stem cell therapy is currently being used in patients in the field of regenerative medicine, with promising results for the treatment of articular cartilage lesions of the knee. The overview of the study could help the beneficiaries to understand to what extent carry novel structural evaluation of knee and how effective is their clinical implications and thereby, take decisions regarding where they can avail help and intervention for their healthy knee. The study provides a base for literature and data for the professionals, who are responsible for developing assisting devices, tools, prostheses, and improved techniques for traditional surgical interventions for the enhanced skills in the various surgical procedures of the knee. The study also serves as a reference for researchers, who wish to conduct studies along similar lines, and help to think about collaborating in the field of modern medicine. Consequently, the usefulness of the anatomical knowledge of the knee joint and the role of ligaments and other structures of the knee in the mechanical design of the knee stands significantly substantial to the researchers in the wide range of research in various fields including Surgery, Radiology, Human Anatomy, Comparative anatomy, Evolutionary Biology, Recent advancement, Regenerative medicine, Anthropology, Forensic medicine, Medical Genetics, Cellular and microbiology, Sports Medicine, Rehabilitation, Medical physiology, Physics, Biomedical Engineering, Mathematics and many others.

3.4 Conceptual framework

The conceptual framework represents the researcher's synthesis of the literature on how to explain a phenomenon as well as a grasp of how the study's specific factors interact. The conceptual framework serves as the researcher's "map" for navigating the investigations, identifying the variables that must be considered during the study process (Patrick, 2015). According to Mc Ganghie, Bordage, and Shea, the conceptual framework clarifies the relationship between the variables and ties to the issue statements (2001). The conceptual framework sets the tone for the presentation of a specific research topic that informs the findings presented in response to the research's problem statement. The self-developed conceptual framework of the present study indicates that the anatomical knowledge of knee joint is assessed based on the cadaveric type of study, side, symmetry and gender dispersion. The knowledge may range from poor, moderate, good or excellent.

3.5 Aim of the study

Any research's ultimate goal is to provide observable and testable evidence that steadily adds to the body of human knowledge (Shuttleworth, 2008). The goal of this work is to highlight the clinical consequences of cadaveric examination and morphometric analysis of the knee joint. The present study aimed to characterize the role of anatomical knowledge of morphometry and morphological analysis of knee joints and its clinical significance for various approaches in the surgeries of the knee. Further, the study is intended to provide an intervention to enhance the knowledge, which might bring about change in the knowledge and existing guidelines to enhance the effectiveness of their treatment. The study also aims to explore the perception and experience the beneficiaries for the healthy knee and find out the correlation for the medical and surgical practices in the physical health.

3.6 Objectives of the study

An objective is something that one's efforts or actions are intended to attain or accomplish or achieve or attain the associated goal (Diffen n.d.). The objective of the research is one of the important elements for researching as it helps in determining the possibility of conducting the study.

The primary objectives of the present work include the following:

1. To describe and measure the morphometry of articular surfaces of the bones contributing in forming knee joint in cadavers.
2. To describe and measure the morphometry of articular surfaces of the patella contributing in forming knee joint in cadavers.
3. To describe and measure the morphometry of articular surfaces of distal end of femur contributing in forming knee joint in cadavers.
4. To describe and measure the morphometry of articular surfaces of proximal end of tibia contributing in forming knee joint in cadavers.
5. To observe and measure morphometric linear measurements patellar ligament of cadaveric knee joint and evaluate bilateral and sexual dimorphism in cadavers.
6. To observe and measure the morphometric linear measurements of extrinsic and intrinsic ligaments of cadaveric knee joint and evaluate bilateral and sexual dimorphism in cadavers.
7. To observe and measure the morphometry of menisci and evaluate bilateral and sexual dimorphism in cadaveric knee joint.
8. To describe and analyze the morphological variations of menisci of cadaveric knee joint.
9. To evaluate any morphological variations in bones or any structures related to the knee joint.
10. To evaluate any anatomical and morphological variations in any muscle, artery, vein and nerve structure of knee joint.
11. To evaluate the anatomical variations in any structure related & surroundings to the knee joint.

3.7 Research Study Design

The overarching strategy that the researcher decides to integrate into the various components of the study in a consistent and logical manner is referred to as the research design. Cresswell (2011) defines research design as "plans and procedures for study that span the decisions from the broad to the specific."

3.8 Population and Sample Technique

3.8.1. Population

Population in research is generally a large collection of individuals known to have similar characteristics. The present study considered donated cadavers available in the different cadaveric laboratory.

3.8.2. Sampling technique

Due to large size of population, the researcher often cannot study every cadaver in the universe as it is expensive and time consuming. Therefore, they rely on sampling techniques to fulfill the objectives. Sampling is a technique to fulfill the objectives. Sampling is a process in which a predetermined number of observations are taken from a larger population (Tuovila, 2019). The sampling technique in the present study is discussed as: considering the no. of cadavers available in the Anatomy department from accessible dissection laboratory of Anatomy Department in Baroda, Gujarat or from the other regions of Gujarat, India. Total sample size of the study.

3.9 Inclusion and Exclusion Criteria

In a common practice it essential in any research to identify the inclusion and exclusion criteria for the specimen in the research. The research must define what specimens should participate in the research, and needs to specify why other specimen cannot participate in the research. Generally, the inclusion of the participants depends on the goals of the study (patino, & Ferreira, 2018). The criteria considered for the inclusion and exclusion of the specimens in the study are given below.

3.9.1. Inclusion Criteria

- All the available specimens of lower limb of embalmed cadaver available in the Department of Anatomy during study period from May 2018 to December 2020 were included in the study;
- All the available specimens, did not have any visible external abnormalities in their lower limb were included;

3.9.2. Exclusion Criteria

- Any specimen of lower limb or cadavers with previously operated in lower limb knee region were excluded;
- Any specimen of lower limb or cadavers with TKR (Total knee arthroplasty) procedure done in lower limb knee region were excluded;
- Any specimen of lower limb or cadavers with established osteoarthritis related changes to knee, signs of patellofemoral disease were excluded;
- Any specimen of lower limb or cadavers with physical signs of deformity of knee were excluded;
- Any specimen of lower limb or cadavers with any damage and autolysis which may prevent the analysis of knee and unsuitable for the study were considered exclusion criteria for the present study.

3.10 Instruments and Materials of the data Collection

The instruments and materials in the data collection are methodologies employed to collect data from the targeted samples to assess the pre-defined parameters. In the present study, digital vernier caliper, cloth measuring tape and non-elastic cotton thread were considered as major tools for the data collection. Determining the tools for the data collection is more significant in any research. The instruments and materials were utilized to collect relevant information from the cadaver towards the cadaveric analysis and morphometric evaluation of knee. Using the right dissection laboratory materials and tools is essential to successful cadaver dissection. The following list of materials and dissection tools allows dissectors to care for their cadaveric donors while acquiring the experience and knowledge of a successful dissection. The description of the instruments and materials for the study is described into the followings:

- **Blocks.** Wooden blocks of different shapes and sizes (6-18 inches) used to position the cadaver and cadaveric lower limb.
- **Plastic Sheets.** Used to cover the cadaver.
- **Plastic sheet for background**
- **Cotton sheet**. To maintain moisture within the cadaver, to prevent drying and to allow dissection of appropriately hydrated tissue.
- **Gloves.** Gloves vary in the type of synthetic material used; both powdered gloves and powder-free gloves available were utilized for the dissection.
- **Scalpel handles with blade.** Standardized Metal scalpel blades utilized to make skin incisions but can also be used to reflect the dermis and areas with dense connective tissue.
- **Forceps (plain, toothed, pointed)-** Large size
- **Forceps (plain, toothed, pointed)-** Small size
- ▪ Toothed forceps enable the dissector to grip tissue without sliding out of the hands. Plain forceps allow the dissector to control delicate tissues during meticulous dissection.
- **Spatula Probe/Pointer.** A probe or tip on one end and spatula on the other was used to highlight dissected structures. The spatula used to aid blunt dissection.
- **Scissor straight and curved**
- **Cloth Measuring Tape.** For measuring distances from landmarks of surface anatomy.
- **Thread, Color pin, Digital camera**

Figure 3.1: Instruments used in present study

3.11 Testing of tools

Pre-testing of the tools includes the validity, reliability, practicability, and sensitivity of the instruments are all tested before they are utilized for actual data collecting. In the present study testing was as per the various methods and its description is given below:

3.11.1 Validity

Validity refers to how well an instrument measures something (Middleton, 2019). The degree to which an instrument measures what it is designed to measure is determined by the validity of the instruments and tools. In the present study, based on the objectives, in the initial phase the correction of the instrument was done by the research guide and on his approval, the researcher preceded for the tool validation. *Content validity* indicates the extent to which items adequately measure that the researcher wishes to measure. In the present study, it was drawn firstly by closing the jaws tightly then, holding a caliper toward a light source and finally, looking through the crack between the legs and see a gap as small as 2.5μm (0.00010 in.). The Vernier caliper is a tool that allows you to measure lengths with greater precision than a metric ruler.

3.11.2 Reliability

Reliability is about the consistency of a measure**.** In order to consider the study as valid, there must be a reliable measurement procedure that assesses the excellence of the measurement procedure used to collect the data in the study (McLeod, 2013). Reliability is about the consistency of a measure. Test-retest reliability is one such test is a measure of reliability done to find out whether the instrument produces the same results each time if it is administered in the same setting to the same specimen. Hence, in the present study, test-retest was done to check the reliability of the instrument adopted for the study.

3.12 Methods of Data Collection

Data collection is a systematic method of gathering from different source of information, which is a crucial aspect in any research, and the proper accumulation of data has a greater impact on the findings of the study. In the present study, this includes research method and research methodology. To understand the theoretical aspects of morphometric evaluation of cadaveric knee joint and to find out the variables used in previous studies, various kinds of literature is referred to base on the available data. Various web sources such as PubMed, Medline, Google Scholar, SAGE publishing, Academic National and International Journals, publications, were used to review the thesis, articles, and government published data. Books and unpublished data are also reviewed by visiting Smt. Hansa Mehta University library and Department library. Present study is based on the examination of ninety cadaveric knee joint of known age and sex from the dissection room. The data is obtained from the dissection laboratory record data, from the Department of Anatomy.

3.12.1 Research Method

An attempt has been made to identify the cadaveric analysis and morphometric evaluations of knee Joint, described in with review of literature, to find out any morphological variations related to knee and to correlate its surgical significance. For this morphometric analysis of patella, distal end of femur, proximal end of tibia, Morphology and morphometric analysis of menisci, morphometric analysis of cruciate ligaments. Morphometric analysis of collateral ligaments, morphometric analysis of oblique popliteal ligament and other variations related to the knee joint has been done. The following are the individual details of each parametric.

The following metric parameters of patella and patellar ligament of knee are measured with the digital vernier caliper:

- **To describe the height/Length of patella:**

  Method: By measuring the linear distance between superior border of patella and apex of patella.
- **To describe the Width of patella:**

Method: By measuring the linear distance between medial and lateral border of patella.

- **To describe the thickness of patella:**

  Method: By measuring linear distance between anterior surface and median ridge on posterior surface of patella.

- **To describe the Width of lateral articular facet:**

  Method: By measuring the maximum width from the lateral border to the median ridge of patella.

- **To describe the Width of medial articular facet**

  Method: By measuring the maximum width from the medial border to the median ridge of patella.

- **To describe the length of patellar ligament:**

  Method: By measuring the linear distance between the apex (non-articular posterior surface) of patella and tibial tuberosity.

- **To describe the Width of patellar ligament:**

  Method: By measuring the linear distance between the two margins/borders of patellar ligament.

- **To describe the thickness of patellar ligament:**

  Method: By measuring the linear distance between the anterior and posterior surface of patellar ligament at proximal and distal part.

Wiberg proposed three shapes based on position of vertical ridge. For the classification of patella, we followed the guidelines made by Wiberg; the details are shown in the table.

Type I	there are roughly equal medial and lateral facets[123]
Type II	most common: medial facet is only 1/2 size of lateral facet[123]
Type III	medial facet is so far medial that the central ridge is barely noticeable[123]

TABLE- 3.14.1: WIBERG CLASSIFICATION OF PATELLA[123]

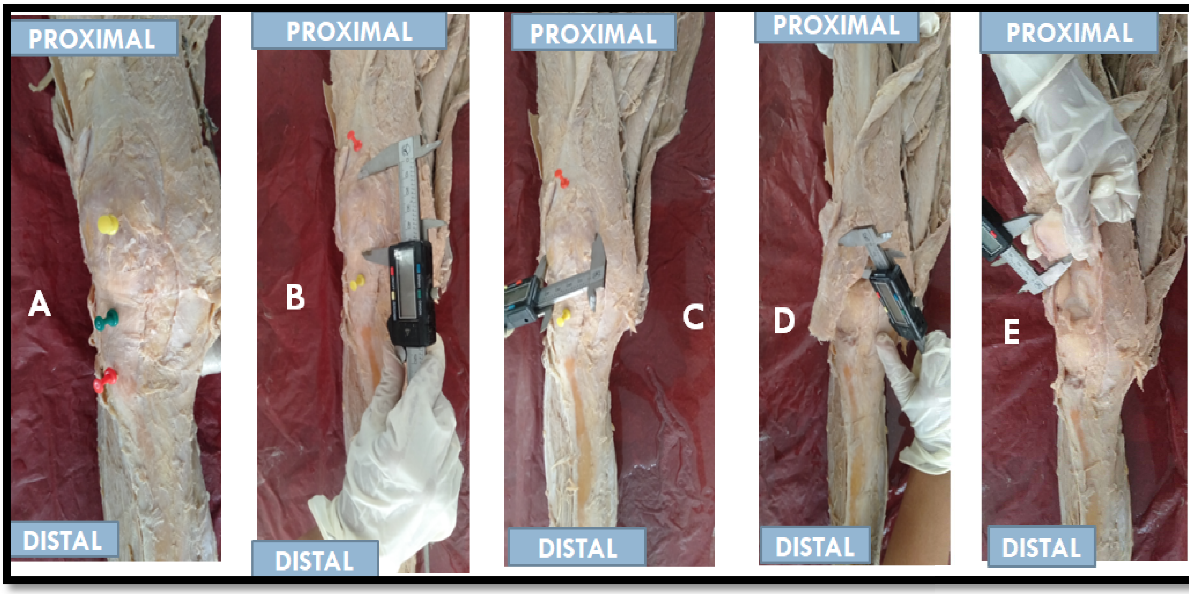

Figure 3.2: Showing morphometric measurements of patella of knee in cadavers–present study. A- Anterior aspect of dissected knee B- Length of patella C- Width of patella D- Thickness of patella E- Width of lateral articular facet

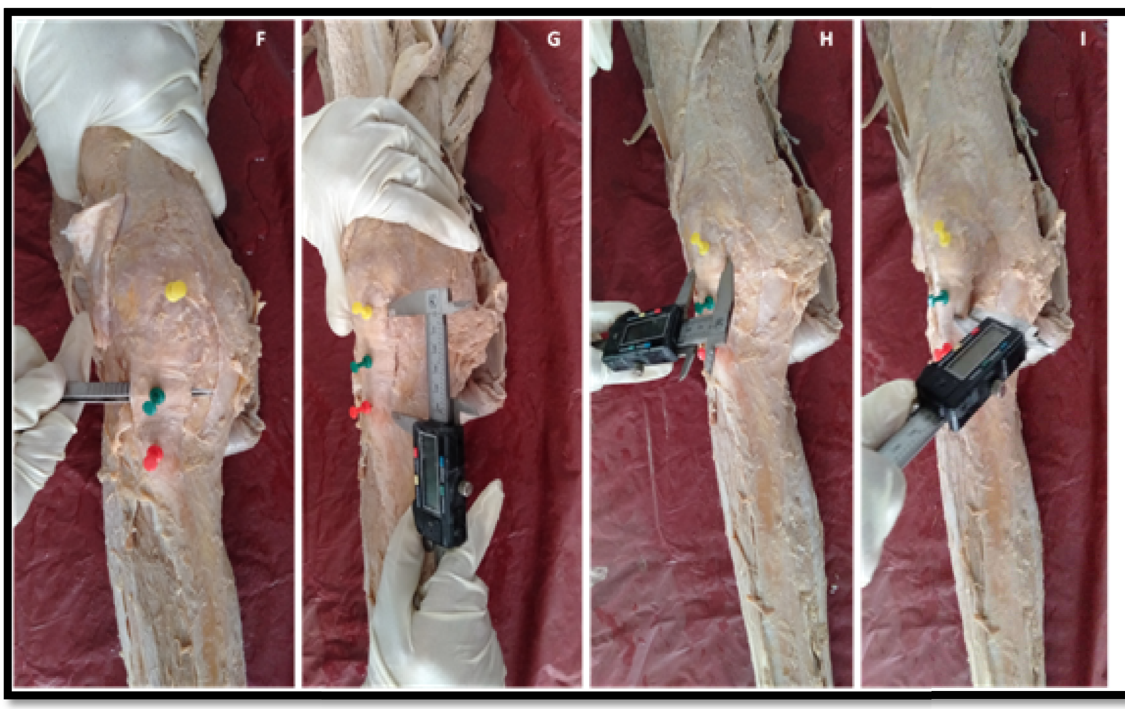

Figure 3.3: Showing morphometric measurements of patellar ligament of knee in cadavers– present study. F- Patellar ligament in dissected knee G- Length of patellar ligament H- Width of patellar ligament I - Thickness of patellar ligament in proximal part.

The following metric parameters of distal end femur contributing in formation of knee are measured with the digital vernier caliper:

- **To describe the Bicondylar width of femur (BCWF):**
  Method: By measuring the maximum distance between the medial and lateral femoral condyle in transverse plane.
- **To describe the Medial femoral condyle antero-posterior diameter (MFCAPD):**
  Method: By measuring the maximum distance between anterior and posterior surface of medial femoral condyle.
- **To describe the Medial femoral condyle transverse diameter (MFCTD):**
  Method: By measuring the maximum distance between medial and lateral surface of medial femoral condyle.
- **To describe the Lateral femoral condyle antero-posterior diameter (LFCAPD):**
  Method: By measuring the maximum distance between anterior and posterior surface of medial femoral condyle.
- **To describe the Lateral femoral condyle transverse diameter (LFCTD):**
  Method: By measuring the maximum distance between medial and lateral surface of lateral femoral condyle.
- **To describe the Intercondylar notch width of femur (ICNWF):**
  Method: By measuring the maximum distance between medial and lateral surface of intercondylar notch of femur posteriorly.
- **To describe the Intercondylar notch length of femur (ICNLF):**
  Method: By measuring the maximum length of intercondylar notch of femur.

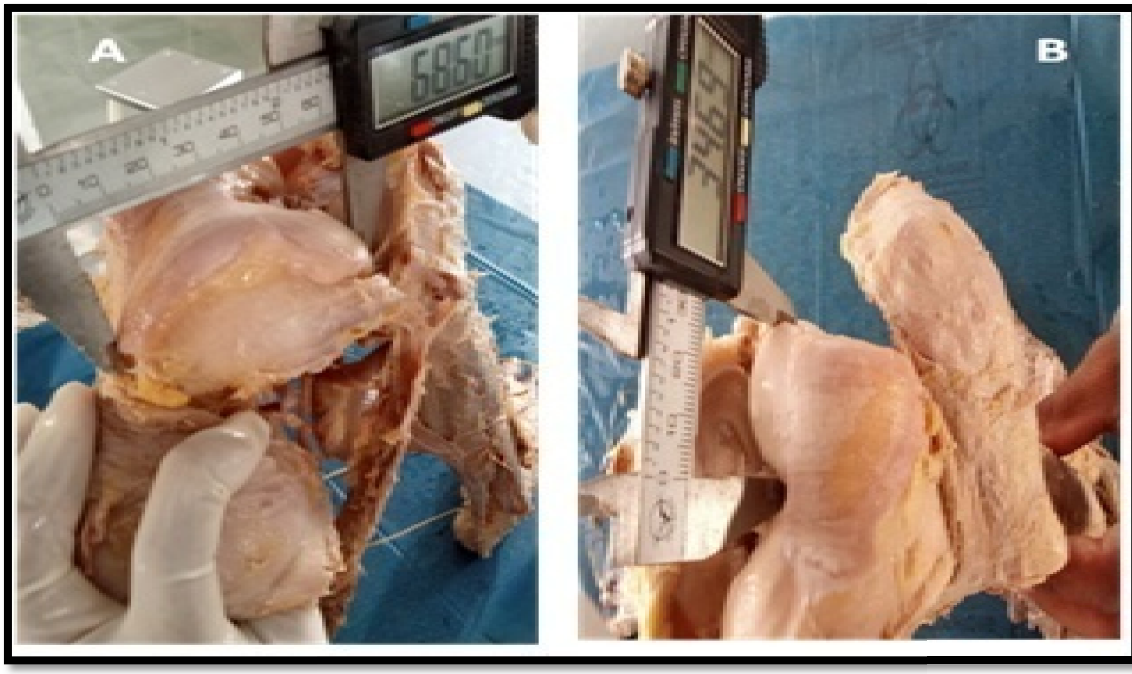

Figure 3.4: Showing morphometric measurements of distal articular surface of femur in cadaver– present study. A- Antero-posterior diameter of lateral femoral condyle B- Transverse diameter of lateral femoral condyle.

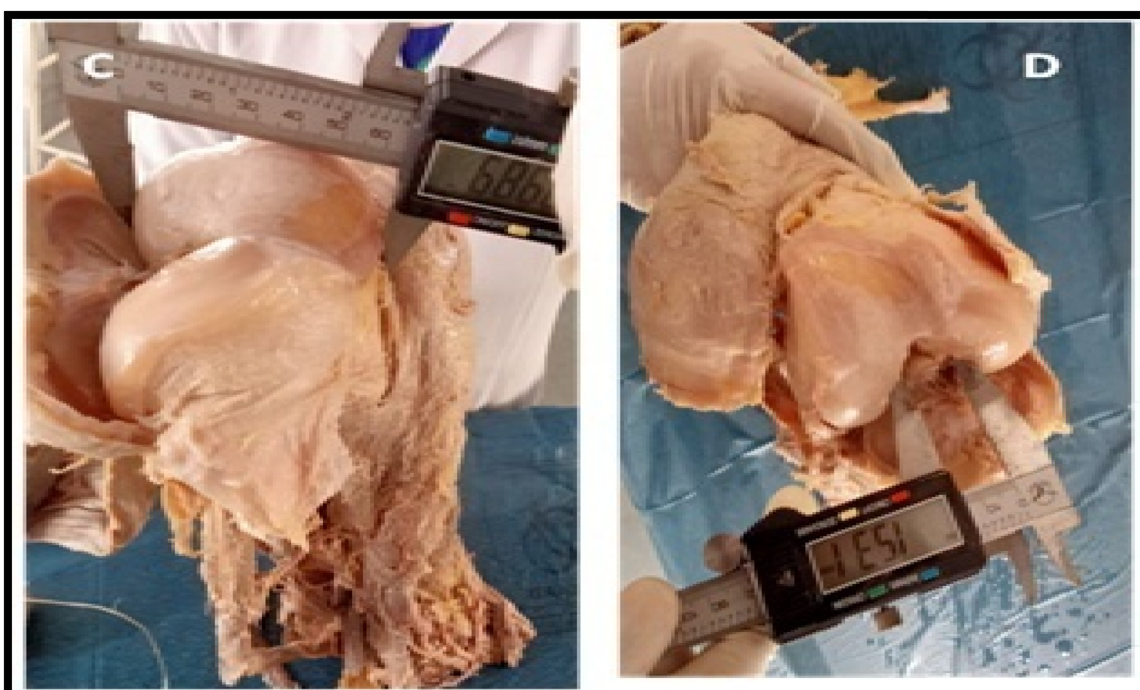

Figure 3.5: Showing morphometric measurements of distal articular surface of femur in cadaver– present study. C- Antero-posterior diameter of medial femoral condyle D- Width of Intercondylar notch.

The following metric parameters of proximal end of tibia of knee are measured with the digital vernier caliper:

- **To describe the Bicondylar width of tibia (BCWT):**

  Method: By measuring the maximum distance across both tibial condyles in transverse plane.
- **To describe the distance from tibial condyle to tibial tuberosity:**

  Method: The maximum distance from tibial condyle to tibial tuberosity.
- **To describe the medial tibial condyle antero-posterior diameter (MTCAPD):**

  Method: By measuring the maximum distance between anterior and posterior borders of superior articular surface of medial tibial condyle.
- **To describe the medial tibial condyle transverse diameter (MTCTD):**

  Method: By measuring the maximum transverse diameter of superior articular surface of lateral tibial condyle.
- **To describe the lateral tibial condyle antero-posterior diameter (LTCAPD):**

  Method: By measuring the maximum distance between anterior and posterior borders of superior articular surface of lateral tibial condyle.
- **To describe the lateral tibial condyle transverse diameter (LTCTD):**

  Method: By measuring the maximum transverse diameter of superior articular surface of lateral tibial condyle.
- **To describe the total anteroposterior measurement of intercondylar area (TOTAL AP ICA):**

  Method: By measuring the maximum distance between anterior and posterior borders of upper end of tibia.
- **To describe the anteroposterior measurement of anterior intercondylar area (AP AICA):**

  Method: By measuring the maximum distance between anterior border of intercondylar area to a line joining intercondylar eminence.
- **To describe the anteroposterior measurement of posterior intercondylar area (AP PICA):**

  Method: By measuring the maximum distance between a line joining intercondylar eminence and posterior border.

❖ **To describe the transverse measurement of intercondylar area (TD ICA):**

Method: The maximum transverse diameter at following three levels:

a) anterior part b) middle narrow part – at the level of intercondylar eminence c) posterior part

Figure 3.6: Showing morphometric measurement of total antero posterior diameter of intercondylar area and distance from tibial condyle to tibial tuberosity.

Figure 3.7: Showing morphometric measurements of medial tibial condyle antero posterior diameter and medial tibial condyle transverse diameter.

Figure 3.8: Showing morphometric measurements of lateral tibial condyle antero posterior diameter and lateral tibial condyle transverse diameter.

Figure 3.9: Showing morphometric measurements of intercondylar area in cadaver– present study. A.- TD ICA (anterior part) B.- TD ICA (middle part) C.- TD ICA (Posterior part)

The following morphology of menisci is analysed and classified by direct observed methodology: To describe the morphological variation in the different shape of medial menisci:

Method:

Crescent shape: thin anterior, posterior horns and thin bodies.

Sickle shape: thin anterior, posterior horns and thick bodies.

C-shape: menisci which resembled sided C.

Sided U- shape: Menisci which resembled sided U.

Sided V- shape: Menisci which resembled sided V.

To describe the morphological variation in the different shape of lateral menisci:

Crescent (semilunar) shape: thin anterior, posterior horns and thin bodies

C-shaped: Menisci which resembled sided C

Discoid (circular): When the meniscus covers the tibial plateau circularly

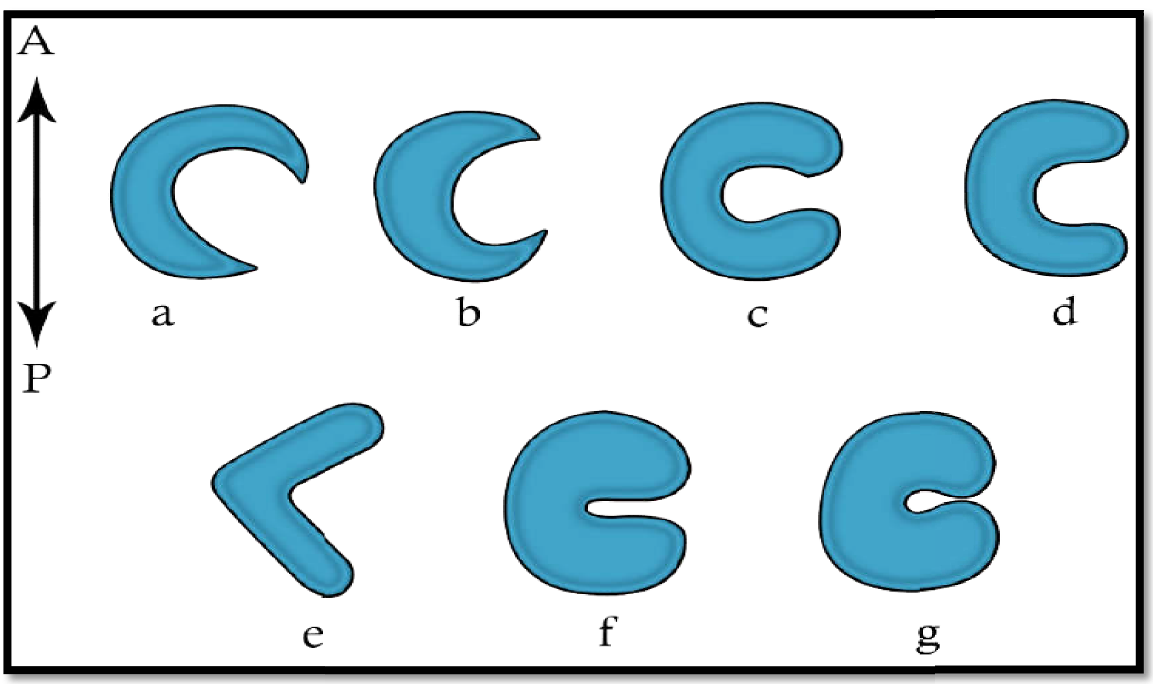

Figure 3.10:Showing various shapes of menisci a. Crescent shaped b. Sickle shaped c. C-shaped d. Sided U-shaped e. Sided V shaped f. incomplete discoid g. Complete discoid.[25]

The following metric parameters of medial menisci and lateral menisci were measured with the digital vernier caliper and non-elastic cotton thread.

- **To describe the length of menisci:**

  Method: Outer circumference measurement from apex of anterior horn to the apex of posterior horn of menisci.

- **To describe the width of menisci:**

  Method:

  Anterior One-third: Linear distance measurement from peripheral margin to the central margin of meniscus in anterior one-third.

  Middle one-third: Linear distance measurement from peripheral margin to the central margin of meniscus in middle one-third.

  Posterior one-third: Linear distance measurement from peripheral margin to the central margin of meniscus in posterior one-third.

- **To describe the thickness of menisci:**

  Method:

  Anterior one-third: linear distance measurement between top and bottom edge from the outer circumference in anterior one-third.

  Middle one-third: linear distance measurement between the top and bottom edge in the outer circumference in middle one-third.

  Posterior one-third: linear distance measurement between the top and bottom edge in the outer circumference in posterior one-third.

Figure 3.11: Showing morphometric measurements of medial menisci in cadaver– present study. Length measured with non-elastic cotton thread, Length measured with vernier caliper, thickness of medial menisci (posterior one-third).

Figure 3.12: Showing morphometric measurements of lateral menisci in cadaver–present study. Length measured with non-elastic cotton thread and vernier caliper, thickness of lateral menisci (anterior one-third), thickness of lateral menisci (posterior one-third).

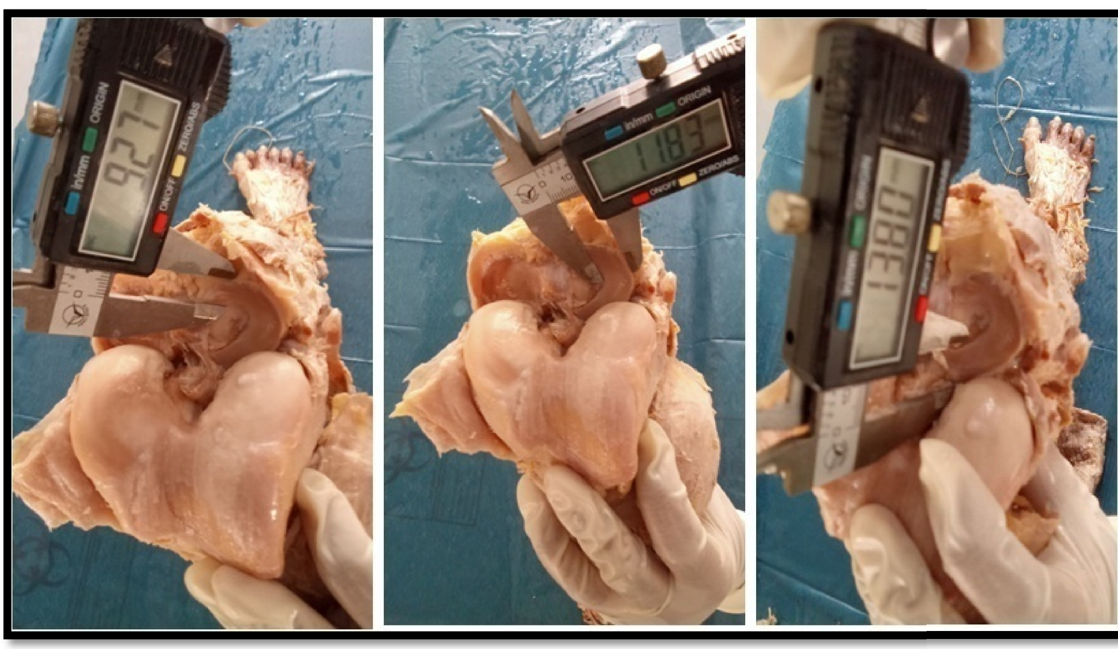

Figure 3.13: Showing morphometric measurements of lateral menisci in cadaver; Width of menisci anterior one-third, Width of menisci middle-one third, Width of menisci posterior one third.

The following metric parameters of various ligaments of knee were measured with the digital vernier caliper, measure tape or thread.

- **To describe the length of superficial medial collateral ligament:**
  Method: The maximum linear distance from the medial epicondyle of the femur to its lower attachment on the tibia.
- **To describe the width of superficial medial collateral ligament:**
  Method: The maximum width of the ligament in the middle part.
- **To describe the length of deep medial collateral ligament:**
  The length of the Menisco-femoral ligament:
  The maximum distance from its femoral insertion to the centre of its insertion on the medial meniscus.
  The width of the Menisco-femoral ligament:
  The maximum distance between the two borders of ligament.
  The length of the Menisco-tibial ligament:
  The maximum distance from its tibial insertion to the center of its insertion on the medial meniscus.
  The width of the Menisco-tibia ligament:
  The maximum distance between the two borders of ligament.
- **To describe the length of lateral collateral ligament:**
  Method: The maximum linear distance from the lateral epicondyle of the femur to its lower attachment on the fibula.
- **To describe the width of lateral collateral ligament:**
  Method: The maximum width of the ligament in the middle part.
- **To describe the width of anterior cruciate ligament:**
- **To describe the length of anterior cruciate ligament:**
  Method: To measure the maximum linear distance from tibial and femoral attachment:
- **To describe the width of anterior cruciate ligament:**
  Method: To measure the maximum transverse linear distance of ligament.

- **To describe the length of posterior cruciate ligament**

  Method: To measure the maximum linear distance from tibial and femoral attachment.

- **To describe the width of posterior cruciate ligament:**

  Method: To measure the maximum transverse linear distance of ligament.

- **To describe the length of transverse ligament:**

  Method: To measure the maximum linear distance from its attachment to anterior horn of medial meniscus to anterior horn of lateral meniscus.

- **To describe the width of transverse ligament:**

  Method: To measure the maximum linear distance from its anterior to posterior border.

- length and width of oblique popliteal ligament:
- Any other findings: We observed the various other morphological variations in relation to the knee joint:

  1) Variations in relationship to the pes anserinus is observed for the: a) Structures constituting in insertion pattern of pes anserinus b) mode of insertion of pes anserinus c) site of insertion of pes anserinus
  2) Variations in relationship to the presence and absence of os fabella under the head of lateral head of gastrocnemius is observed and analyzed for its maximum length and maximum width.
  3) Variations in relationship to the plantaris muscle is observed during the study; therefore we made an attempt maximum length and width of belly of muscle; maximum length and width of tendon of plantaris muscle; and maximum length of plantaris from its proximal to distal attachment is measured.

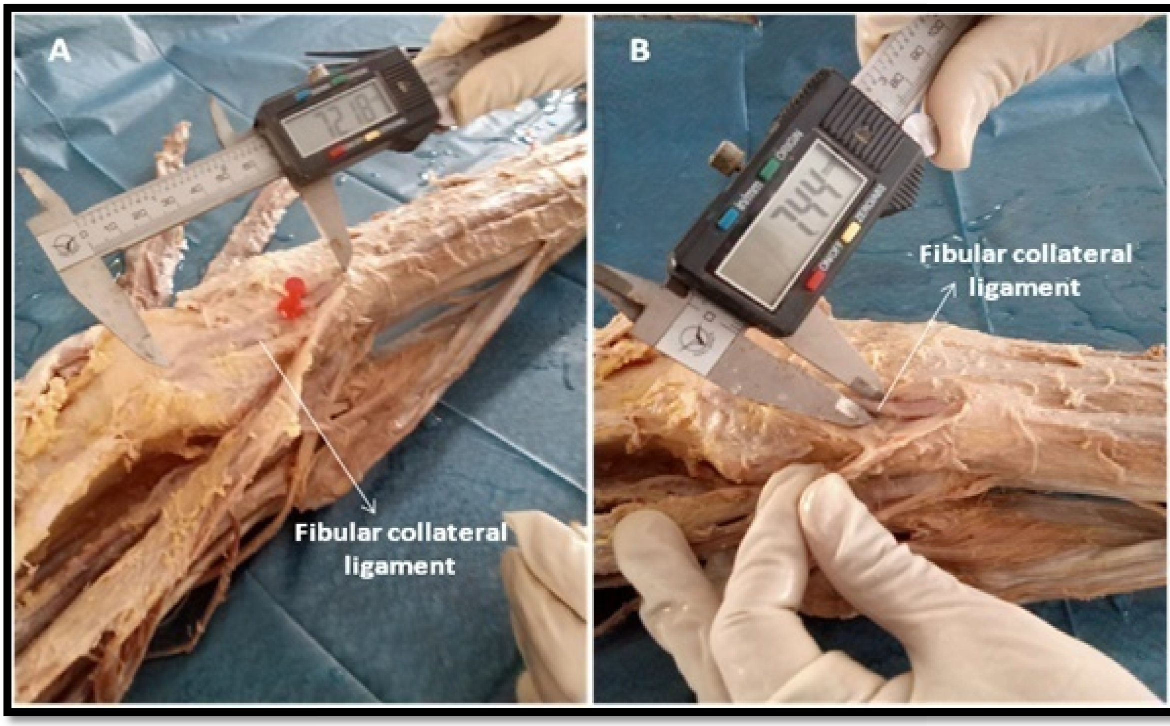

Figure 3.14: Showing morphometric measurements of fibular collateral ligament in cadaver – present study. A-Length B-Width

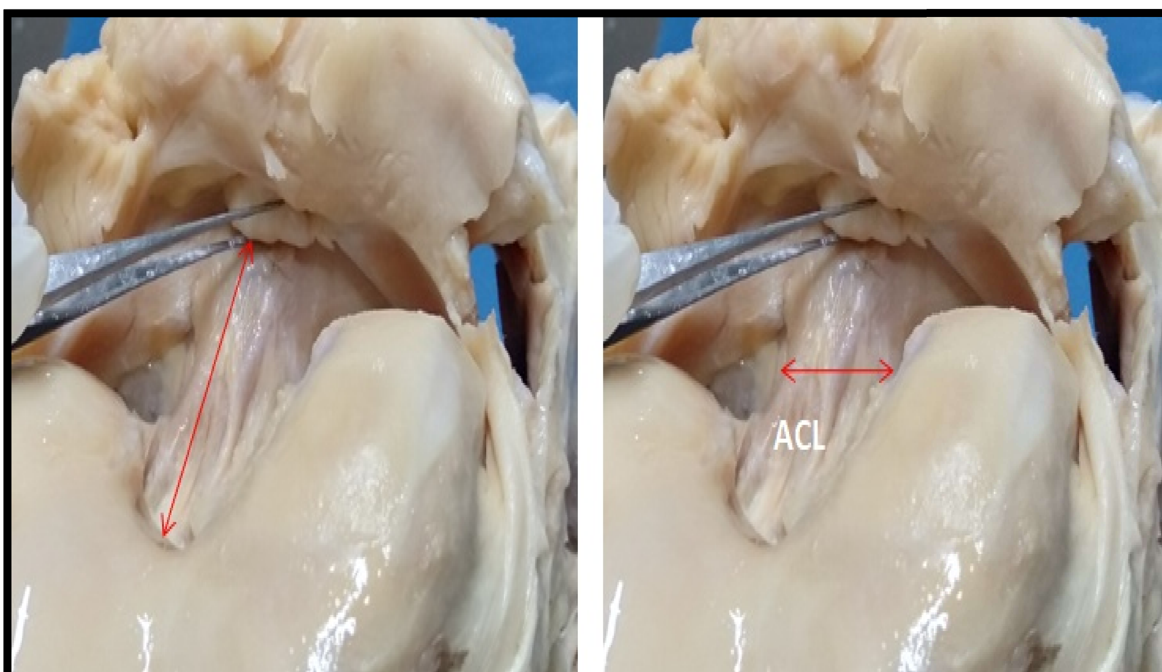

Figure 3.15: Showing morphometric measurements of length and width of anterior cruciate ligament in cadaver – present study.

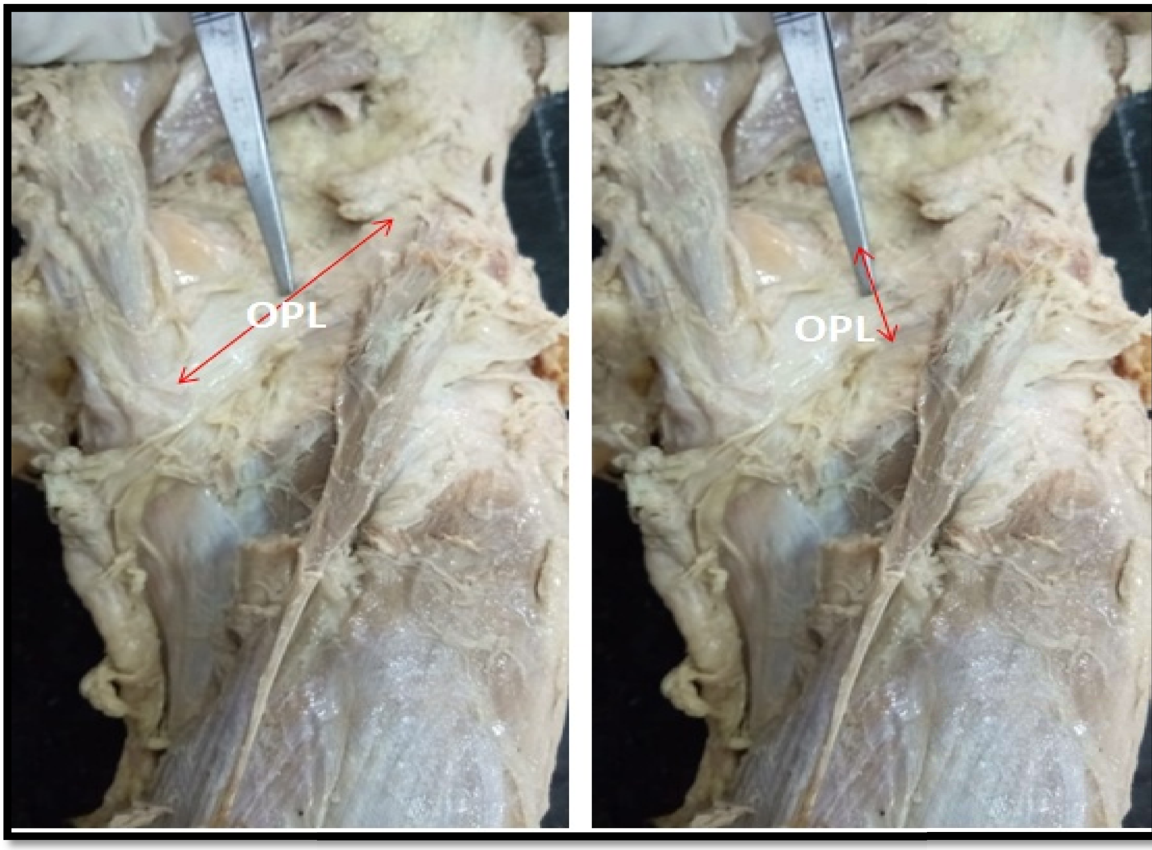

Figure 3.16: Showing morphometric measurements of Length and mid-width of oblique popliteal ligament.

3.12.2 Research Methodology

Embalming procedure of the cadaver:

Present study is carried out in the cadaveric laboratory of Anatomy Department. The Specimens are taken from the 'Will' to donate donor's own dead body or by the relatives as a Body donation available in the Anatomy department for the education and research purpose in the medical field. Ethics and Care of embalming are strictly followed. The donated cadavers were embalmed by the arterial embalming method by carotid arterial perfusion or by femoral arterial perfusion with the embalming preservatives prepared by mixing up of formalin-10%, glycerine-20%, spirit, water, glycerin, sodium chloride, and eosin. Cadaver is then preserved in week formalin solution for the storage before the dissection.

Data collection methodology:

This is an observational study carried out after obtaining approval from Institutional Ethics committee (IERCH) Medical College Baroda, Gujarat. The specimens for the present study included of adult human cadaveric lower limb of known age, gender and side available during the study period in the department of Anatomy. Total Ninety properly embalmed and formalin fixed lower limb of adult cadavers are selected for the study. The study group comprised of sixty-two males and twenty-eight females with equal number of right and left sided as forty-five right sided and forty-five left sided. The specimens are taken for a sample as per available in the department and only suitable for the study after obtaining permission from the head of the department.

The detailed history of cadavers collected from the record register. Each previously embalmed formalin fixed knee joints are dissected. The Limbs are observed for any changes or for any of the exclusion criteria. All the available specimens are checked for its inclusion and exclusion criteria. An only specimen which satisfies our study criteria is dissected. Dissection is done under the guidance and supervision of guide; any required intervention is carefully taken and observations are made after dissecting the cadavers. Vernier calipers with a minimum count of 0.01 mm and a cloth measuring tape are used to record all measurements.

Data collection procedure:

- Cadaver or cadaveric lower limb is positioned in the supine position, the knee joint is observed. The gender and side of the limb is determined. The specimen is observed carefully, inspection of the knee is done for the inclusion and exclusion criteria for the study.
- An incision is made on the medial sides of the knee in the knee region with the help of scalpel. Dissection is performed with forceps (plain, toothed, pointed) and scissor. Initially the skin and soft tissues surrounding the knee joint is removed.
- Proximally, the quadriceps femoris tendon and the patellar ligament are found to be linked to the patella. The medial patellar retinaculum and lateral patellar retinaculum is thick and robust fascia on the medial and lateral sides of the knee joint.

- The medial and lateral retinacula are cut, and the patellar ligament and the tendon of the quadriceps femoris muscle is exposed. The fat is cleaned properly for freeing the muscle in direction to expose the quadriceps tendon, the patella and the patellar ligament.
- The tendon of the quadriceps femoris muscle attaching to the patella is identified. The patellar ligament and the strong, thick fascia on the medial and lateral sides of the knee joint, the medial and lateral retinacula of the knee are identified.
- The parapatellar sheath is removed. The patella and patellar tendon are exposed meticulously.
- The morphometric linear measurement of the patellar ligament is done. The maximum patellar ligament length, the maximum patellar ligament width at the middle part and, the maximum patellar ligament thickness in proximal part and distal part were measured in millimeter using a digital vernier caliper. The data is photographed, recorded and analyzed statistically.
- The tendon of quadriceps femoris and the patellar ligament are carefully freed from the underlying structures without causing any damage or alteration to the desired structures.
- The patella is separated from the subcutaneous prepatellar bursa and subcutaneous infrapatellar bursa. The surrounding fat is cleaned meticulously. The morphometric linear measurement of the bones taking participation in the formation of knee joint including articular surface of patella, articular surface of distal end of femur and articular surface of proximal end of tibia is done. Initially, the morphometric linear measurement of the patella is done. The maximum height of patella, the maximum width of patella, and the maximum thickness of patella were measured.
- With the scissor, patellar ligament is cut close to the tibial tuberosity. Then, the patella IS reflected superiorly preserving the attachment of quadriceps femoris. The maximum width of medial articular facet (WMAF) and the maximum lateral articular facet (WLAF) of patella were also measured. The data IS measured in millimeter by the digital vernier caliper, photographed, recorded and analyzed statistically.
- Based on the dimension of WMAF in relation to WLAF, each patella IS classified into one of three categories: Type A (WMAF=WLAF), Type B (WMAF<WLAF) or Type C (WMAF>WLAF).

- The patella in few specimens is subsequently released by freeing the tendon of the quadriceps femoris from the superior border of the patella as well.
- The transverse incision is given in knee region. The incision is continued with a scalpel lateral and medial to the patella. The vastus medialis is cut from the medial side of the knee along with the vessels and nerves above and below the joint in order to expose the capsule and ligaments of the knee joint.
- On the medial side of the knee joint, the common insertion of the pes anserinus, Sartorius, Gracilis and Semitendinosus are dissected and observed for its constitution, formation, and any anatomical and morphological variations. The pes anserinus is then reflected superiorly and superficial part of tibial collateral ligament is identified as a thick band of connective tissue related to the medial epicondyle of the femur and is measured for the maximum length, mid width with the digital vernier caliber and observed for the any anatomical variations. Deep part of the tibial collateral ligament fused with medial menisci and capsule of knee joint. SMCL is sectioned and Meniscofemoral ligaments and meniscotibial ligaments are dissected and exposed.
- On the lateral side of knee joint, the tendon of biceps femoris is cut with the scissor from the head of fibula to expose the fibular Collateral ligament. The maximum length and mid width of fibular collateral ligament is measured with the digital vernier caliber.
- On the anterior aspect then the infrapatellar fat pad, alar folds and infrapatellar synovial fold is removed to expose the cruciate ligaments crossing each other and the medial and lateral menisci which are fibrocartilaginous plates present between the femur and the tibia. The capsule is removed from the posterior aspect of knee, ACL and PCL are identified and morphometric analysis is done. The structures attached to the upper surface of the tibia is observed and analyzed for any variations in the inter relationships. The femoral and tibial attachment of cruciate ligaments is cut very close to the bone with the help of a scalpel.
- The medial and lateral menisci are identified, observed and classified for the morphological variations in its shape and measured for the length, width and thickness at anterior one-third, middle one third and posterior one third. All their attachments, length and mid width measurements are noted.

- The presence and absence of the transverse ligament of knee connecting both the anterior horn and posterior horn of medial and lateral menisci are identified and measured for the length, width and its prevalence of presence and absence.
- Medial and lateral condyles and epicondyles of the femur are identified. Intercondylar notch of femur is identified and observed for the attachment of anterior cruciate ligament and posterior cruciate ligament. By flexing the knee joint, the measurements for the anterior cruciate ligaments were taken with the digital vernier caliper and thread both. Later on, the ACL ligament is cut with the scissor to expose the posterior cruciate ligament. Measurements of the PCL are taken.
- In the upper end of tibia, the bicondylar width of tibia, antero-posterior and transverse diameter of medial tibial condyle and lateral tibial condyle, the total length of intercondylar area, antero-posterior and transverse diameter of anterior intercondylar area and antero-posterior and transverse diameter of posterior intercondylar area, transverse diameter of middle part of intercondylar area and distance from tibia to the tibial tuberosity are measured with the help of digital vernier caliper and the data is recorded.
- Then, the limb is placed in the prone position to remove the popliteal vessels, tibial nerve and common peroneal nerve. The semimembranosus muscle is detached. The oblique popliteal ligament passing upwards and laterally from the attachments of the semimembranosus, supplementing the posterior surface of capsule of knee joint is identified. Reflect the plantaris, medial and lateral head of gastrocnemius muscle from the capsule of knee joint. The fabella under the lateral head of the gastrocnemius is identified. The presence and absence of fabella is observed and its morphometric measurements are taken.
- Identify the tendon of popliteus muscle, oblique popliteal ligament and arcuate popliteal ligament. The tendon of popliteus is cut to expose the posterior wall of capsule of knee joint. Remove the capsule of knee joint and to expose the joint cavity and to see the posterior cruciate ligament.
- Observe, analyze and measure the morphometry of oblique popliteal ligament and arcuate popliteal ligament in the posterior aspect of knee.
- Any morphological and morphometric variations related to any soft tissue, muscles, ligaments and bones related to knee joint are observed and recorded.

3.13 Data analysis

Data analysis is the systematic application of statistical tools to explain, illustrate, condense, summarize, and evaluate acquired data in order to discover meaningful information (Grant, 2020). The acquired data is analyzed in accordance with the study's objectives and hypotheses. Statistical product and Service Solution (SPSS) application is used to code the data and to develop a master sheet, while descriptive statistics such as mean score, maximum, minimum, mode value, standard deviations, standard error of mean, is used to analyze the data. The data is measured by using digital vernier caliper in millimeters (in mm). The hypotheses are tested with various statistical tools such as t-value and p-value of all the parameters for symmetrical pattern and gender dispersion. The t-test is applied to find the overall correlation between the male and female sexes and right and left side is used to present the data.

The analysis of the study is done based on the direct observation and morphometric analysis, for which the collected data entry is done and analyzed by using Microsoft Excel.

3.14 Variables

Variables occupy an important role in any research. These are defined as characteristics or features that vary and can be measured, that may change from the subject-to-subject, group-to-group or from person-to-person. In the present study dichotomous variables including symmetrical pattern on right and left side; and gender dispersion as male and female difference is taken into the consideration.

3.15 Ethical Issues

The ethical clearance of the present observational study carried out after obtaining approval from Institutional Ethics Committee for Human Research (IECHR), Medical College, and S.S.G. Hospital Baroda, Gujarat. Though, present study is not contributing direct benefit to the donated cadavers. Confidentiality of the data gathered is maintained to be used only for the study and publication. Privacy of other parts of the cadaver during data collection is taken care of, and no any physical harm is done in the study. In conclusion, author declares No ethical issues were involved in the present study.

3.16 Limitations

The limitations of a study are its shortcomings that can be result of small sample size, unavailability of resources, imperfect methodology etc. However, no study is completely perfect or inclusive of all the aspects (Price & Murnan, 2014). Therefore, listing the limitations of the study reflects honesty and transparency and shows that the researcher has a complete understanding of the topic.

Limitations to the present study is in regarding the number of samples size involved in this study, as larger sample size with multicenter involvement to ascertain better outcomes and to establish clinical implications of the results. A digital vernier caliper is the best tool for quantitative analysis but for the larger results measuring tape and non-elastic thread raises reliability and validity issue, Study relies on the direct morphometric measurement evaluation from the cadaver as compared to some studies where measurements were taken from radiographs, CT scan, MRI or Intra operative methodology.

The studied specimens were of known age and gender, but cadaveric limb in many specimens did not belong to the same individual. The extent to which the persons who have the knee participate in physical activity is unknown. Similarly, little is known about these people's socioeconomic origins, including their occupations, nutritional condition, growth patterns, and whether or not they had any pathologies or illnesses.

Tissue fixation is often required for the preservation or sectioning of the tissue. Furthermore, the accuracy of the measurements is limited because to the formalin-fixed structures in the corpse as soft tissue fixation in formalin causes shrinkage, altering the structure of the original tissue (5% - 10%).

Moreover, to date, no pertinent research in literature is found to study this aspect.

3.17 Chapter Scheme

The research is categorized into six chapters:

Chapter I – Introduction: This chapter contains a brief explanation on anatomy of knee joint, Function of knee joint, Joints of knee complex, Structure of knee joint, Ligaments related to knee joint, Soft tissue surrounding to knee joint, Bursae related to knee joint, Relations of knee joint, movements of knee joint, locking and unlocking movement of knee joint, muscles producing movement at knee joint, biomechanics of knee joint, kinematics of knee joint, soft tissue mechanics, The knee and gait.

Chapter II – Review of Literature: This chapter presents reviews of the studies identified by the researcher from both western and Indian sources. These reviews pertain to other related studies on the patella, related studies on the distal end of femur, related studies on the proximal end of the tibia, related studies on the menisci, related studies on the other ligaments of the knee, other related studies to the knee, variables identify in the review of literature and research gap in the study.

Chapter III – Research Methodology: This chapter includes the methodology adopted for the study. The rationale of the study, the significance of the study, the scope of the study, conceptual framework, the aim of the study, objectives, hypothesis, research design, sampling technique, inclusion and exclusion criteria, instruments and materials of data collection, data analysis, ethical issues, limitations, and chapter scheme were included in this chapter.

Chapter IV – Observations and Results: Based on the objectives, the collected data is analysed with the help of SPSS, and various test such as t-test, p-value were applied to determine the association and correlations between the variables.

Chapter V – Discussion, Data Analysis and Data Interpretation: The section is one of the parts of a research, in which an author describes, analyzes the data, and interprets the findings in comparison with study done by different authors. It explains the significance of those results and interprets the results to the primary research objectives.

Chapter VI – Findings, Recommendations and Conclusion: The last chapter summarizes the findings of the study, and based on the findings, recommendations are given, and the conclusion drawn.

Chapter Summary:

The methodology chapter denotes the overall plan adopted for the study. To enhance the cadaveric analysis and morphometric evaluation of the knee joint; the present study is carried out, and directly observed cross-sectional study is used to accomplish the objectives, while convenience sampling meaning available sample is used to select the specimen after analyzing for inclusion and exclusion criteria from the cadaveric laboratory of Department of Anatomy, Gujarat state. The cadaveric specimens were evaluated in the lower limb knee region, and the data collected is analysed using statistical methods. Thereafter, the clinical implication of the knowledge is deliberated.

The present study is an observational Cross- sectional study. The study is carried out after obtaining approval from Institutional Ethics Committee for Human Research (IERCH), Medical College and S.S.G. Hospital Baroda, Gujarat. Total Ninety properly embalmed and formalin fixed lower limb of adult cadavers were selected for the study. Depending on inclusion/exclusion criteria, All the available specimens, did not have any visible external abnormalities in their lower limb were included. Any cadavers with previously operated in lower limb knee region, established osteoarthritis related changes to knee, signs of patellofemoral disease, physical signs of deformity of knee, any damaged and autolyzed specimens which may prevent the analysis of knee and unsuitable for the study were considered exclusion criteria for the present study. All embalmed cadaver available in the Department of Anatomy during study period from May 2018 to December 2020 were included in the study. All the Observations were made after dissecting the cadavers. An incision is made on the medial aspect of knee.

The subjects were included from 35-85 yrs. old, belonging to both the sexes (62 males and 28 females), and both sided (45 right and 45 left sided). We collected the information after taking information on a prescribed proforma (Appendix-1). After reviewing the literature, the proforma is created. Initially, a pilot study is conducted to determine the proforma reliability and validity. The final proforma thus, evolved is utilized for this study. The limitations to the study were unavailability of the physiological parameters like weight, height and BMI and formalin fixed tissue.