APPROXIMATE BONE ANALYSIS

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ABSTRACT

The paper presents that the results of approximate bone analysis. Here by using a software called COMSOL Multiphysis, we created a appropriate bone model in the geometry plane of the software used. Then by fixing the bottom of bone model we apply different pressure on the top and by observing the plots Von-mises stress and displacement we can analyze the bone.

Keywords—COMSOL MULTIPHYSICS, Approximate bone, Calcareus fractures, Displacement.

I. INTRODUCTION

The skeletal system supports and protects the body while giving it shape and form. This system is composed of connective tissues including bone, cartilage, tendons, and ligaments. Nutrients are provided to this system through blood vessels that are contained within canals in bone. The skeletal system stores minerals and fats and produces blood cells. It also provides mobility.

Tendons, bones, joints, ligaments, and muscles work in concert to produce various movements. Bones are a major component of the skeletal system. Bones that comprise the human skeleton are divided into two groups. They are the axial skeletal bones and appendicular skeletal bones. An adult human skeleton contains 206 bones, 80 of which are from the axial skeleton and 126 from the appendicular skeleton. Here in this project we are creating a approximate bone model using COMSOL software and we applied pressure to the model, to know how much pressure or load it can withstand.

Calcareus fractures are painful and difficult to treat injuries[1]. The quality of a good functional outcome is related to a good anatomical reconstruction. The contralateral uninjured bone is often used a reference to assess the severity of the damage and the quality of the repair. This is currently done with Böhler's angle which has to be drawn on X-Ray images. The authors of this study propose the use of 3D reconstruction images of the hind foot and analyze the symmetry of healthy hind feet. Several measurements were recorded among the 3D reconstructions images of 46 pairs of uninjured feet: mean distances between facets and area of the calcaneal facet of the posterior subtalar joint, orientation angle of the posterior subtalar joint facet and talocalcaneal angle in the space. The difference among all measurements was not statistically significant between the left and the right side, with a high power, which suggests a good symmetry of the calcaneus.The calcaneus has a complex anatomy and segmented 3D image gives a very realistic overview of this tarsal bone. Several measurements on 3D images of 46 pairs healthy feet showed a good symmetry between left and right. It supports the use of the uninjured side as a reference when treating fractured calcaneus.

The angles can be used in evaluating the repair of the anatomy after osteosynthesis, like Böhler's angle on X-Ray images. If confirmed on patients who underwent osteosynthesis of DIACF, it may become a new indicator in the treatment of this difficult to treat injury.The calcaneus has a complex anatomy and segmented 3D image gives a very realistic overview of this tarsal bone. Several measurements on 3D images of 46 pairs healthy feet showed a good symmetry between left and right. It supports the use of the uninjured side as a reference when treating fractured calcaneus. The authors describe angles, which can be used in evaluating the repair of the anatomy after osteosynthesis, like Böhler's angle on X-Ray images. If confirmed on patients who underwent osteosynthesis of DIACF, it may become a new indicator in the treatment of this difficult to treat injury.

Risk of osteoporosis is increasing in normal population due to inactivity, dietary eating habits, and sedentary life styles, low calcium intake, less exposure to sun light and hormonal changes. Physical therapy interventions, weight bearing training, jumping intervention in childhood and adolescence, modified step aerobics training, balance training, strength training and water based exercise can be used for treatment and prevention of osteoporosis(eg. [2]).

Aging is associated with osteoporosis. Physical activity and physiotherapy interventions can be used for treatment and also for prevention. Risk of osteoporosis is increased with inactivity, stroke and chronic diseases. Bone loading is an effective way of bone nutrition and osteobalstic activities.

Physical therapy interventions, weight bearing training, jumping intervention in childhood and adolescence, modified step aerobics training, balance training, strength training and water based exercise can be used for treatment and prevention of osteoporosis.

Recent advances in wireless sensors and medical telemetry are promising new and hitherto unexplored opportunities in orthopaedic implants. This implies miniature unobtrusive sensors that are implanted along with the orthopaedic device and used to wirelessly communicate information to exterior monitoring/control equipment. This information may be related to the status of the medical device itself and/or the health status of the surrounding biological tissues. This paper provides a review of orthopaedic implants with wireless communication capabilities. Example application reported to date are discussed, along with challenges raised (biocompatibility, wireless interface and power), and future directions.

Orthopaedic implants are rising as one of the most commonly performed surgeries in the area of orthopaedics. Recent advance in wireless health care miniaturized sensors and wireless powering are promising to significantly uplift the capabilities of orthopaedic implants by integrating all sorts of smart functionalities. The almost goal is a much better quality of life for individuals with orthopaedic implants. This paper presented a review of the current status in the field, discussing existing applications and challenges, and providing directions for future research. The aim of this paper is to analyse the total displacement of approximate bone.

II. METHODOLOGY

The input is pressure is applied to tibia which is the longest bone of human body. The tibia bone is made up of calcium, minerals, glucose and water. The pressure is sensed by the capacitive pressure sensor as output. The Figure 1 shows the block diagram of monitoring the pressure sensor at knee using capacitive pressure sensor.

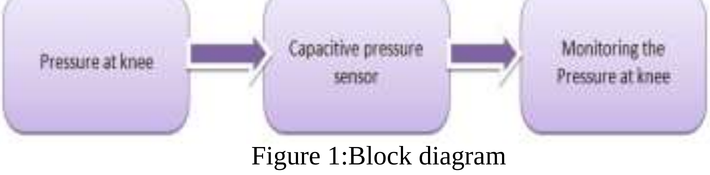


Figure 1:Block diagram

The approximate bone is designed carried out for analysis of von-mises stress and displacement as shown in Figure 2. COMSOL Multiphysics provides a number features for creating geometric primitives and for operating on approximate bone, from the available geometry structures in COMSOL Multiphysics, Bezier polygon is chosen for construction of bone. Bezier polygon structure is generally a chain of connected line segments, quadratic or cubic curves. By choosing appropriate control points a closed curve forming a polygon structure is build in work plane. The 3D structure is formed as an extrude one.

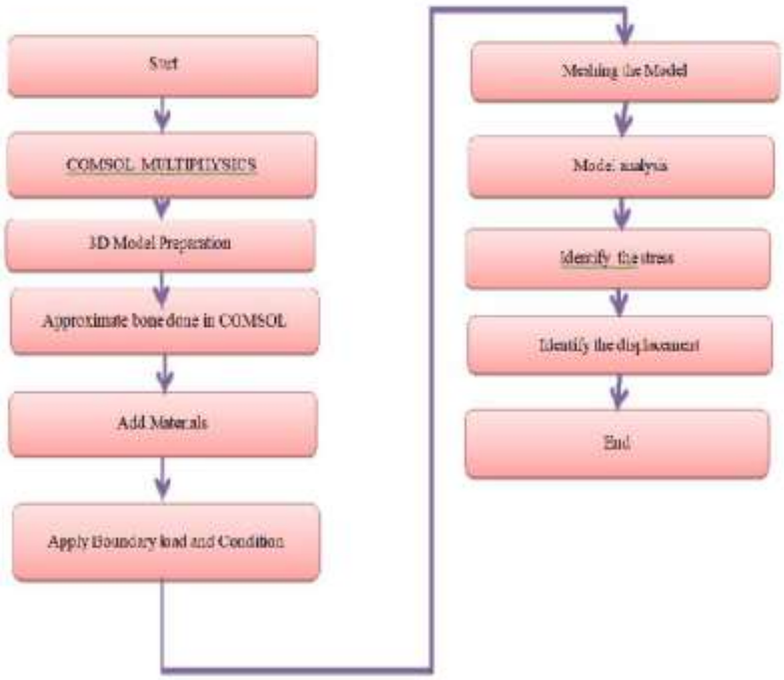


Figure 2: Flow chart of approximate bone

Now another work plane is selected and here control points are chosen in order to form a fillet and placed at a distance of 0.4micrometer from work plane which form as an extrude,by intersecting these two extruded objects geometry of bone is created . Next step is addition of material to the prposed geometry browsing all the available data bases a specific material is chosen and properties are assigned to the chosen material. The Calcium is chosen from the material browser and apply the pressure of 25[pa] and 50[pa] on the bone using boundary load and fixed the lower edge of bone using fixed constraints and apply normol mesh for finite element analysis. Add solid mechanism, the study is stationary the two surfaces are used to obtain von –mises stress and displacement. Then bone is considered for simulation and observed the value of von-mises and displacement for different pressure.

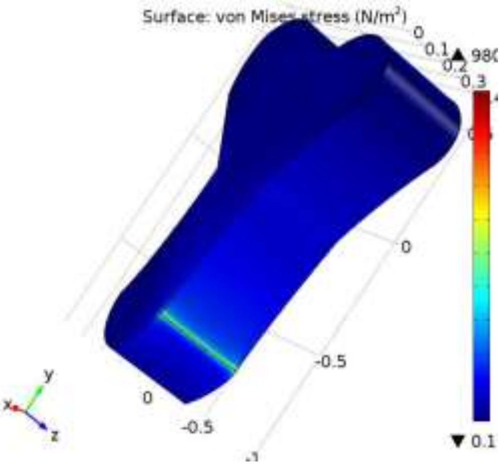
III. SOFTWARE DESCRIPTION

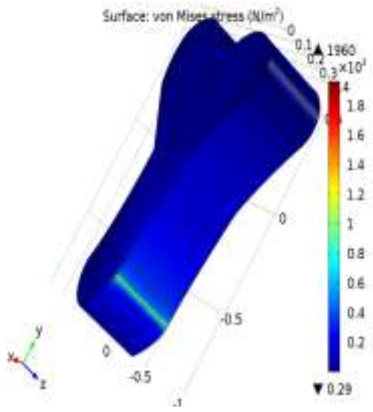
Comsol Multiphysics Software is a simulation platform that encompasses all of the steps in the modeling workflow. Defining geometries, material properties, and the physics that describe specific phenomena to solving and post processing models for producing accurate and trustworthy results.

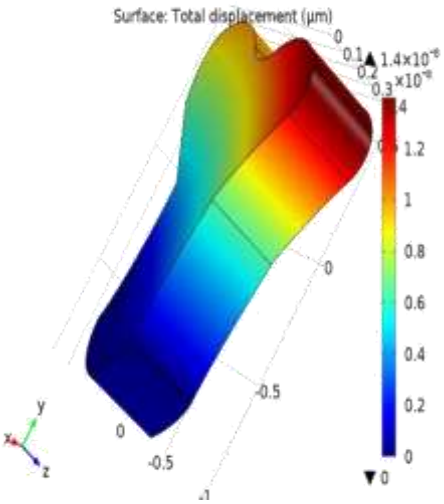
The core comsol multiphysics package provides geometry modeling tools for creating parts using solid objects, surfaces, curves and Boolean expressions. Geometric entities such as materials domains and surfaces can be grouped into selections for subsequent use in physics definitions, meshing and plotting. The import of all standard CAD and ECAD files into Comsol multiphysics is supported by the CAD import module and ECAD import module, respectively.

IV. RESULT AND CONCLUSION

The below models shows the Von-Mises stress and Total displacement for the applied pressure mentioned in the table as shown in table 1. The first, two model shows the Von-Mises stress and the next two model shows theTotal displacement as shown in table 2. In this we took total displacement result values of all approximate, actual bone by applying different pressure and also compared the values of both approximate and actual bone 3d models and observed that the both values are similar. This ensures that monitoring the bone diseases.All the observations and procedural working of the model are mentioned in the paper and results have been discussed elaborately.







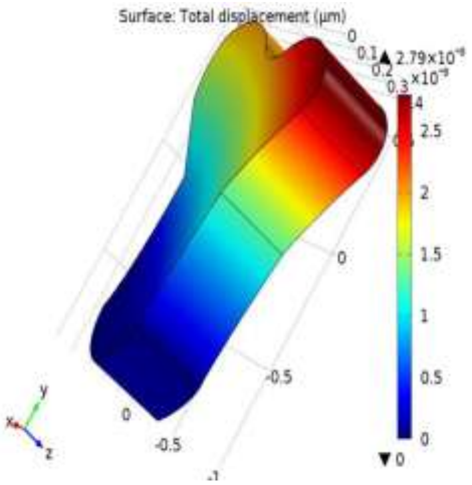


Table 1: Von Mises Stress

Pressure	Stress Of Approximate Bone	Stress Of Actual Bone
25[pa]	980 N/m^2	1.01*10^4N/m^2
50[pa]	1960*10^3N/m^2	2.94*10^4N/m^2

Table 2: Displacement

Pressure	Displacement of Approximate Bone	Displacement Of Actual Bone
25[pa]	0.144*10^-6m	0.19*10^-6m
50[pa]	0.0279*10^-6m	268*10^-6m

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