IN-SILICO ANALYSIS OF ALIGNMENT OF HUMAN KNEE JOINT USING FINITE ELEMET METHOD FOR DESIGNING OF ARTIFICIAL KNEE

A Major Project submitted in partial fulfillment of the requirements for the award of the degree

MASTER OF TECHNOLOGY

IN

BIOMEDICAL ENGINEERING

Submitted by
ATUL TIBREWAL (2K13/BME/04)

Under the supervision
Prof. B. D. Malhotra
Department of Biotechnology
Delhi Technological University
Delhi-110042, INDIA

CERTIFICATE

This is to certify that the M.Tech. dissertation entitled "***In-Silico*** **Analysis of Alignment of Human Knee Joint Using Finite Element Method for designing of Artificial Knee"**, submitted by **Mr. Atul Tibrewal (2K13/BME/04)** in partial fulfillment of the requirement for the award of the degree of Master of Technology of Delhi Technological University, Delhi (Formerly Delhi College of Engineering, University of Delhi), is an authentic record of the candidate's own work carried out by him under our joint guidance and supervision. The information and data enclosed in this dissertation is original record of his work which has not been submitted elsewhere for the award of any other degree or diploma in India or abroad for the purpose other than the first above mentioned.

Date: ___________ **Atul Tibrewal**

Dr. Sadaf Fatima
Assistant professor
Department of Biotechnology
Faculty of Natural Sciences
Maulana Mohammed Ali Jauhar Marg
Jamia Millia Islamia
New Delhi- 110025

Prof. B. D. Malhotra
Department of Biotechnology
Delhi Technological University
Delhi-110042, INDIA

Prof. (Dr.) D. Kumar
Head
Department of Biotechnology
Delhi Technological University
Delhi- 110042

DECLARARTION

I hereby declare that the work presented in this dissertation titled " **In-silico Analysis of Alignment of Human Knee Joint Using Finite Element Method for Designing of Artificial Knee**" is an authentic record of my own work carried out under the joint supervision of Dr. Sadaf Fatima, Assistant Professor, Department of Biotechnology, Jammia Millia Islamia, Delhi and Prof. B.D. Malhotra, Department of Biotechnology, Delhi Technological University, Delhi- 110042.

I further declare that to the best of my knowledge, this dissertation does not contain any work or part thereof which has been earlier submitted for any award either in this university or in any other university/ institute.

Atul Tibrewal

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Atul Tibrewal

(2K13/BME/04)

ABSTRACT

The finite element (FE) model of knee joint is extremely useful tool for orthopedic surgeon while evaluating the biomechanics of joint of a patient when suspecting an injury, especially in case of sports injury. To begin with this study, the 3-D FE model of human healthy knee was reconstructed using CT-DICOM images with image algorithms that included the main structures of knee joint bones.

Total Knee Arthroplasty (TKA) is a surgical procedure to replace the weight bearing surfaces of the knee joint with metal and plastic components in order to relieve pain and disability. It is most commonly performed for osteoarthritis and also for other diseases such as rheumatoid arthritis and psoriatic arthritis. Longevity of TKA depends to a greater extend on its alignment during surgery. Most of the current alignment methods rely upon the knee surfaces the morphology of knee in average patients. In normal knee, the femur is oriented inwards and the alignment of the tibia is directed outwards to provide a foot alignment that is parallel to the ground, this alignment is known as Genu- Valgum. In this case, an even distribution of the subject’s weight is inserted in the knee. For obese patients, the thighs are naturally abducted (directed outwards), which creates a case of Genu Varum. Even with this variation in the alignment of the femur and tibia, these patients receive the same alignment of average patients.

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S.N.	BMI-	Body Mass Index
1.	CAD-	Computer Aided Design
2.	CES-	Cambridge Engineering Selector
3.	CT-	Computed Tomography
4.	FEA-	Finite Element Analysis
5.	FBD-	Free Body Diagram
6.	GRF-	Ground Reaction Force
7.	LCL-	Lateral Collateral Ligament
8.	MCL-	Medial Collateral Ligament
9.	NURBS	Non-Uniform B-Splines
10.	OA	Osteoarthritis
11.	PCL	Posterior Cruciate Ligament
12.	STL	Stereo Lithography
13.	TKA	Total Knee Arthroplasty
14.	TKR	Total Knee Replacement