



Project Proposal for Ph.D.

Project Details

Project Title

Design of protective guards for sports related maxillofacial injury

Project Summary

(Minimum 500 and maximum 2000 characters)

Sports activities, particularly contact sports have an associated risk of orofacial injuries because of falls, collisions, contact with hard surfaces and sports equipment. Sports accidents reportedly account for 10-39% of all dental injuries in children. Tooth fractures (59.7%) were the most common dental injuries and nose (84.7%) was the most frequently fractured facial bone. The American Academy of Paediatric Dentistry (AAPD) advocates the use of a mouthguard for prevention of oro-facial injuries.

Boxing is a unique sport wherein 'the nature of the activity involves insult by intention rather than by accident.' Patterns of injury differ between professional and amateur boxing since professional boxers fight for more rounds (up to 12 rounds compared to 3 in amateur) and wear lighter gloves 8oz (227g) as compared to 10oz/12oz (284g/340 g) in amateur. Professional bouts last from 4 to 12 with each round of 3 minutes whereas amateur boxing has 3x3 minute rounds. Boxing, being an indoor sport, gives a varied context for analyzing maxillofacial injuries through use of motion capture systems and pressure sensor deployment. Further, NCCT Head and Face 40/64 MDCT (multidetector scanner) scanner will be used to reconstruct at intervals of 0.7mm along with Hounsfield value of cortical/cancellous bone will be recorded at various defined points. High resolution CT scans of ten subjects (five males and five females) in three different weight categories i.e. light weight, light middle weight and heavy weight will be recorded for validity and will be used to create the STL geometry for the model. Segmentation and meshing of the model will be done. Material properties will be assigned for the finite element model construction.

The objective will be to a) attenuate the impact requiring material damping and b) distribute the localized forces to a broader area of the jaw which demands stiffness. These two objectives demand judicious selection of materials and assignment of geometry. The finite element model will be used to modify a nominal volume through topological optimization to minimize the injury. The design of the guard may have to change with the sport and proficiency of the participants.

Ph.D. Supervisors

Role	Faculty	Academic Unit in IITD/Institute/University	Email ID (Official)
Supervisor 1	Prof. Sudipto Mukherjee	Department of Mechanical Engineering, IIT Delhi	sudipto@iitd.ac.in
Supervisor 2	Prof Deepak Gupta	Dept. of Neurosurgery, AIIMS Delhi	drdeepakgupta@gmail.com

Project requirements (Student qualifications, experience required, etc)

- BDS, MDS
- 3 years residency with a teaching/research institution specializing in maxillofacial injury.

Source of fellowship/funding

(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Candidate with his/her own fellowship/ part-time/sponsored candidature.

Role of Faculty Members involved:

1. Dr. Sudipto Mukherjee, Department of Mechanical Engineering IIT Delhi will guide with execution of the experiment, finite element analysis and design of the guard for impact mitigation.
2. Dr. Deepak Gupta, Professor of Neurosurgery will guide with medical scans and clinical inputs on faciomaxillary and concussion injuries.