Minutes of MGM Centre of Human Movement Science "Annual Meet"

10th October 2016

MGM Centre of Human Movement Science (MGMCHMS)held its first "Annual Meet" on 10th October 2016.The Centre was established one year ago on 5th October 2015 and it is now time to reflect on events of the past year as well as complete on activities to be undertaken in the forth coming year. MGMCHMS received immense support from International Society of Biomechanics (ISB) and is formed in partnership with Indian Institute of Technology, Bombay (IITB) .Dignitaries from all over the country participated in the Meet. MGM Institute of Health Sciences was represented by Hon Chancellor Prof K.G. Narayan Khedkar , Pro Vice Chancellor Lt Gen DrS.K.Kaul, Pro Vice Chancellor (Research)DrChanderPuri, Director Research (Engineering) DrVinodSuri, Medical Superintendent of MGM Hospital - DrK.S Salgotraand DrSwagatika Mishra from Department of Prosthetics and Orthotics.The IITs were represented by Prof B.Ravi(Institute Chair Professor and Head ,BETIC),DrRupeshGhyarand DrTrimbak(PT)from IITB , DrKanagaraj from IIT Guwahati and DrSujathaSrinivasan from IIT Madras. Other members present were Prof AnandKhandekar, VishwaNiketan College of Engineering, DrHemantBansali ,Mr Rajiv Mehta from RatnaNidhi Trust,DrGiridhar Sharma - Scientific Officer –F ,BARC and the core team of MGMCHMS inclusive of founder team leader -DrRajaniMullerpatan , DrBelaAgarwal(PT) , DrYuvraj Singh(PT) and DrTriveniShetty(PT).

A formal welcome in form of "The Biomechanical Dance" enthralled the eminent guests which was followed by presentation of events of the past year by DrRajaniMullerpatan .Key roles played by Dr Andrea Hemmerich , then officiating ISB member , Dr Robert van Duersen ,Cardiff University ,UK and Prof B. Ravi in setting up of MGMCHMS was duely acknowledged.

DrRajani elucidated on need of generating normative references applicable to Indians for variables related to movement analysis as existing reference values have been generated from the West and using these norms may lead to over or underestimation of musculoskeletal issues problems faced by Indians.

An extremely interactive session with the dignitaries participating actively and providing constructive feedback led to an interesting discussion on whether varied lifestyle would alter muscle length-force relations in Indians.

Dr. Rajesh B. Goel
Registrar
MGM Institute of Health Sciences
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Navi Mumbai- 410 209

The guests were informed about two ongoing extramurally funded projects. A collaborative project between Department of Mechanical Engineering,IITB and MGM Institute's University Department of Physiotherapy, Navi Mumbai aimed towards developing a powered trans-tibial prosthesis for people with below knee amputation; funded by Department of Biotechnology. The second interdisciplinary collaborative project between Department of Mechanical and Materials Engineering, Queen's University, Canada , MGM Institute's University Department of Physiotherapy and S.N.D.T. Women's University, Mumbai , India aimed to evaluate birthing positions in non-pregnant women; is sponsored by the Natural Sciences and Engineering Research Council (NSERC-Canada) and the Shastri Indo-Canadian Institute.

Research conducted by PhD scholars and post-graduate students of Physiotherapy and engineering waselaborated upon whereby DrKakodkar commented that,"This is much more than biomechanics". Delving into neurodynamics and postural control of human movement were enriching the projects and it was suggested that carefully designed focused studies need to be undertaken to enable understanding

musculoskeletal issues and variations in Indians across various socio-economic strata.

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With respect to product designing,DrKakodkar opined that stakeholder interest needs to be considered, outreach activities need to be planned to include students from medical and engineering backgrounds. Opening the Centre to professionals across disciplines and institutes was applauded and considered beneficial in terms of revenue generation and expansion of the Centre. Another suggestion was to use integrated musculoskeletal assessment to generate norms with an objective of early identification of musculoskeletal disorders rather than dealing with the problems once they have been established. DrKakodkar suggested that,"The wisdom of traditional Indian lifestyle needs to be taken to the global community".DrRajaniinformed that the forthcoming ISB conference in 2017 would have a section dedicated to Indian Biomechanics.

In the arena of training and task force generation various suggestions were received. Gist of the discussion was that basic course in biomechanics needs to be introduced into curricula of medical and engineering courses. DrBansali suggested that MUHS should be approached to undertake such a venture for health related courses. Advanced course in biomechanics could be offered to mechanical/civil/designing related engineering fields or a Fellowship program could be started .A mastersprogram in Biomechanics in collaboration with an international university like Cardiff University would enhance uptake of the program .DrKakodkar emphasized that it was important to create a 'common lingua' between biological sciences and mechanical sciences so that intelligent communication between the two was made possible. He also stated that, "Ours is a country with a schizophrenic attitude where we get caught between basic

science research and technology based product development" and that it would be an arduous task combining the two.

DrRajani concluded her presentation by mentioning new projects in pipeline and expressing gratitude towards staunch support received from MGM Trust, IITB, the core MGMCHMS team and student strength of MGM Institute's University Department of Physiotherapy, Navi Mumbai.

The meeting continued with DrSujata from IITM presenting her phenomenal work in the area of assistive devices and using appropriate technology to design indigenously engineered functional devices to address local needs.Dr Kanakraj from IITG presented his work on innovative designs of prosthetic knee joint and DrTrimbak presented work on socket designs and 3D printed socket made from images taken via mobile phones or simple body measurements. Prof Ravi concluded saying that, "Biology is the mother, mechanics is the father of biomechanics" and a true integration between the two would be needed for future progress in the field.

DrKakodkar summarized the meeting by providing his insight saying that,"For anything to progress beyond individual effortneeds a strong ecosystem and integration between stakeholders who find use for the facilities. Creating a system of rating health care products using facilities at the Centre, relevant to Indian life style and becoming the authorized facility to rate products should be a goal". He appreciated that MGMCHMS was creating a new model of working by combining academics, research and product designing.

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Dr. Rajesh B. Goel
Registrar
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Navi Mumbai- 410 209

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MGM Centre of Human Movement Science
MGM Institute's University Department of Physiotherapy
Sector-1, Kamothe, Navi Mumbai – 410209

Integration of Biomechanics in health care: addressing India's unmet needs

Roundtable Meeting on Status and Future of Biomechanics Research in India

MGM CHMS, 6th May 2017, 12:30 – 16:30 hr

Minutes of the meeting

Participants:

Name	Affiliation	Responsibility / Research Interests
Prof. PrabhatRanjan	Executive Director,TIFAC, New Delhi	Chairman of the meeting
Prof. K.G. Narayan Khedkar	Chancellor,MGM IHS, NaviMumbai	Co-Chair of the meeting
Lt.Gen.(Dr)S.K.Kaul	Pro Vice Chancellor, MGM IHS, NaviMumbai	Co-Chair of the meeting
Prof. RajaniMullerpatan	Director, MGMCHMS, Navi Mumbai	Clinical biomechanics in health care
Prof. Robert van Deursen	Founder, Research Centre for Clinical Kinaesiology, Cardiff University, UK	Research and integration of clinical biomechanics in rehabilitation
Prof. B.Ravi	Institute Chair Professor of Mechanical Engg. and Founder, BETiC, IIT Bombay	Indigenous medical device innovation
Prof. Sujatha Srinivasan	Founder, R2D2,IIT Madras	Design of assistive devices
Prof. S. Kanagaraj	Professor, IIT Guwahati	Design of lower limb prosthesis
Dr. S.N.Omkar	Chief Research Scientist,IISc Bangalore	Yogasana biomechanics
Prof. Abhishek Gupta	Professor, Design Group, IIT Bombay	Design of lower limb prosthesis
Prof. AsimTewari	Professor In-Charge, NCAIR, IIT Bombay	Advanced materials and manufacturing
Dr. RupeshGhyar	SEO, BETiC, IIT Bombay	Bioengineering, Orthopedic implant testing
Shri. Sanjeev Sharma	Scientist, BARC, Mumbai	Robotics
Prof.Jindal	MGMCET,MGMIHS	Biomedical eng. applications in healthcare

Agenda: The circulated agenda includedfollowing items:

1. Sharing of information related to Biomechanics at MGMCHMS and the institutes of invited experts.
2. Brainstorming to identify collaborative R&D initiatives related to clinical biomechanics in healthcare
3. Discussions to prioritise and evolve a roadmap for implementation of selected initiatives
4. Any other item

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Proceedings:

1. **Prof.RajaniMullerpatan**welcomed the Chair, Co-chairs and all scientists / experts present.

2. **Prof. Narayan Khedkar** welcomed Prof.PrabhatRanjan and the assembled scientists, and mentioned that MGM Institute is happy to support R&D activities in the area of rehabilitation led by Prof.Rajani, and to collaborate with other institutes.

3. **Lt. Gen.(Dr) S.K. Kaul** also echoed the sentiments expressed by the Chancellor, and mentioned the critical need as well as the role of clinicians in supporting such R&D work.

4. **Prof.PrabhatRanjan** presented a copy of the *Technology Vision 2035: Medical Sciences and Healthcare Roadmap*, to MGMIHS Chancellor Prof. Narayan Khedkar, and briefly described the vision and mission therein. He mentioned that assistive technology for rehabilitation has been identified by the Government as one of the focus areas.

5. **Prof. Robert van Deursen** recalled his long association with Prof.Rajani and expressed his happiness as well as satisfaction in seeing a world class Gait Lab coming up in India (MGM CHMS). The initial projects, clinical data collection and the three courses in Biomechanics conducted at the Centre have created a strong foundation for future activities, he said.

6. **Prof. B. Ravi**briefly described his journey into medical engineering, and the establishment of BETiC (Biomedical Engineering and Technology incubation Centre) at IIT Bombay, with support from the State Govt. of Maharashtra and DST, New Delhi. He appreciated the deep commitment of Prof.Rajanifor creating the CHMS facility and initiating many important projects, even with funding constraints. He mentioned some of the novel medical devices being developed at BETiC, including those in collaboration with MGM-CHMS, likeprosthetic leg and diabetic foot ulcer screening device.

7. **Prof. Sujatha Srinivasan** briefly described the work being carried out attheirRehabilitation Research &Device Development (R2D2) lab, which focuses on applying biomechanics and mechanism design principles to develop assistive devices and tools for rehabilitation, such as standing wheelchair, prosthetic knee, swimming pool lift, body-movement wheelchair, add-on for outdoor mobility, and orthotic knee joints, which have undergone user trials.The team has also developed a mathematical model for human walking that uses minimal kinematic inputs to predict the kinetics, and are using this model as a basis to develop a wearable sensor system for gait analysis outside lab settings. Partnering with MGCHMS is enhancing their ability to address new clinical problems and design biomechanically appropriate devices, and a MoU is being finalised, she said.

8. **Prof. S. Kanagaraj**shared information about their work in developing assistive devices for rehabilitation, which is currently focussed on a unique polycentric knee joint to allow high flexion activities such as squatting required by Indian population. His other research interests arebiomaterials, nano-composites for biomedical applications, and materials characterization. A start-up company called “Assistive Devices Technology Pvt. Ltd.” has been formed to commercialize the products being developed in his research group.

9. **Dr. S.N Omkar**mentioned his association with PadmavibhushanYogacharyaDr. B K S Iyengaras well as his research interest inYoga biomechanics. A proposal in this field submitted by him to SATYAM has been accepted.

10. **Prof.AsimTewari**showed the high flexion assistive foot made out of aerospace grade carbon fibre for diabetic neuropathy patients, which allows them to ambulate duringthe healing of foot ulcers. He also mentioned that other competencies (such as image processing, machine learning and data analytics) and facilities at NCAIR - National Centre for Aerospace Innovation and Research at IIT-B can be useful for healthcare applications.

11. **Prof.Abhishek Gupta** shared his interest and collaboration with MGM CHMS in rehabilitation engineering, including designing orthoses and powered trans-tibial prostheses for human testing and further design development. This work has been funded by the Department of Biotechnology, Govt. of India.

12. **Dr.RupeshGhyar**briefly mentioned the medical device innovation process at BETiC, starting from identifying unmet clinical needs to device fabrication, clinical trials and licensing to industry. He mentioned the importance of testing the devices, and the framework developed by him for comprehensive evaluation of orthopaedic implants and prostheses.

13. **Shri.Sanjeev Sharma** shared his experience at the Robotics division at BARC, Mumbai, and mentioned that his group is interested in setting up facilities for gait studies in their organisation.

14. **Prof.RajaniMullerpatan**then presented an overview of the research, clinical service, training and partnership activities at MGM CHMS since Oct 2015, which are summarized here.

    Research projects include national and international interdisciplinary collaborative projects related to healthcare in major areas addressing India’s current unmet healthcare needs, namely:

    - Normative research to generate reference bands for meaningful research in clinical biomechanics for Indian people.
    - Biomechanical studiesand generation of robust scientific evidence of *Yogasanas*for their scientific integration in mainstream Indian and global healthcare.

- Biomechanical, radiological and biochemical studies of *traditional Indian lifestyle postures*(like cross-legged sitting) to revive them for prevention of early neuro-musculo-skeletal degenerative effects in the present population.
- Maximize functioning/reduce disability: Exploration of long-term functional outcome of children with *cerebral palsy* and develop mobile apps to monitor change and ultimately maximize function as they grow and reduce disability.
- Biomechanical evaluation of gait and other functional activities such as sit-to-stand, squat; balance performance and energy cost of ingenious*lower limb prostheses* for below-knee and above-knee amputees, in collaboration with IIT Bombay, IIT Madras and IIT Guwhati.
- Study on *birthing postures* showed kneel squat position had maximum pelvic outlet, in collaboration with Queen's University, Canada and SNDT Mumbai;funded by Indo-Canadian Shastri Foundationand NSERC, Canada.
- Projects in non-communicable diseases, particularly diabetes at various stages of patient-careare in process:
  i. prophylactic: a device for early detection of risk of foot ulceration
  ii. foot ulceration: a device to off load the foot when the ulcer occurs which will enable the patient to ambulate to maintain his functional independence and simultaneously allow healing of ulcer.
- Scientific studies to enhance sports performance, such as badminton, kabaddi, and Mallakhamb.
- Exploring biomechanical demands and benefits of traditional Indian dance forms.

The above and other research projects are being carried out by Mastersstudents (M.Tech& MPT) and PhD students.Most of the projects (except where indicated otherwise) are currently funded by MGMIHS, Navi Mumbai; there is a pressing need to secure external fundingto sustain growing research work.

Clinical services:Patients with movement disorders benefit from objective robust evaluation of movement which helps in specific precise planning of surgical and non-surgical comprehensive treatment. Patients with cerebral palsy,stroke, Parkinson's disorders, diabetic neuropathy, sports injuries are tested at MGMCHMS.

Training programmes: Three 3-day certificate courses on Clinical Biomechanics were organized in the last two years, benefitting78 clinicians (physiotherapists, Orthotist-prosthetists, and medical graduates), and 33 engineers (mechanical, electronics, biomedical and computer science)from hospitals,academia, research institutes and industry. These enabled inter-disciplinary interactions between the participants, and provided a basic understanding of basic methodology of movement analysis, principles of biomechanical modeling, theories of movement control and loading.

15. **Brainstorming session** was devoted to identification of promising areas of collaborative research initiatives in healthcare, which are of national relevance, especially those relevant to the needs of the underprivileged and underserved sections of society, and in line with the interests of the scientists present.

- Prof.Rajaniemphasized the importance and strong needfor technology innovations at primary health care level or home-based for elderly people to detect risk for falls and minimize injury. Prof.PrabhatRanjan shared his experience of working on a project called '*Harmony'*funded by Ambani group in 2009. Prof. Ravi mentioned the work of Prof. Neeta Kanekar, Biosciences Dept of IITB in this area. Devices to protect head injuries after falls were discussed.

- A strong need for assistive technology to maximize functional independence of people with rheumatoid arthritis was also voicedby Prof.Rajani.

- Management of diabetic neuropathy through suitable technological interventionswere discussed.Dr.RupeshGhyarmentioned infra-red technology for monitoring wound healing.

- One suggestion (by Prof.Rajani) was to set up a tele-health care centre at MGMIHS, since it has good access to underserved rural people of Thane and Raigad districts. Funding support could be sought from NGOs.

- Prof. K.G. Narayankhedkar expressed his concern about the physical and mental health of young people constantly using smart phones as well as IT professionals, who are at risk of musculo-skeletal conditions.Prof. Ravi mentioned the strong interest of Dr. Sunil Nadkarni, spine surgeon in Pune, to collaborate with researchers working on this problem.

- Dr.S.N.Omkarhighlighted the need for a common platform to promote Biomechanics in India. Prof.Ravi wondered if a professional body (like Biomechanics Society of India) could be created, or would a chapter of International Society of Biomechanics would be a better option. Prof. Robert advised forming an independent society, which could be affiliated to ISB. He mentioned that Prof.Rajanihas been invited to be a member of the Executive Council of ISB, which will facilitate the above initiatives. Prof.Abhishek Gupta suggested that a proposed society should represent a broader theme like human movement science, technology and applications to healthcare, instead of restricting to biomechanics alone.

- There were some discussions regarding the difficulty of obtaining government funding for private institutes like MGMIHS, to support the research, development and training activities. Prof.PrabhatRanjan and Prof. Ravi suggested that this could be partially overcome through joint projects and other initiatives with public institutions. Prof. Sujatha shared her experience of funding from government agencies, private organisations, and international institutions.

16. **Future action plan:**discussions included finalising the areas of collaborativeresearch, expanding the network of researchers, and accelerating more work in this field.

(a) Prof.PrabhatRanjanappreciated the discussions among the experts from leading institutions across the country, and thankedProf.Rajani for arranging the meeting. He mentioned that while India is galloping in some fields like IT and BT (Biotechnology), quality healthcare is still out of reach of most of the population in the country. There is a need for mind-set transformation by moving from doctor-centric to patient-centric care approach in healthcare, he said.

(b) All experts agreed on the pressing need and potential benefits of integrating clinical biomechanics in Indian healthcare. This requires inter-disciplinary collaborative work, especially in the areas of Yoga, diabetes, lifestyle postures andassistive technology (particularly for people with amputations). Generating gait data for Indian population and postures, its analysis, and creation of mathematical models for use in various applications was also identified as being important.

(c) Thrust areas of common interest and respective collaborating institutes were identified as follows.

Thrustareas	**Partner Institutes**
Yoga	MGMCHMS +IISc Bangalore + SVYASA
NCD: Diabetes	MGMCHMS + IIT Bombay
Lifestyle postures	MGMCHMS + IIT Madras
Assistive technology for amputees	MGMCHMS +IIT Bombay + IIT Madras + IIT Guwahati
Gait data modelling and analytics	MGMCHMS + IIT Bombay

(d) All experts presentunanimously agreed to support the formation of a professional body or society of Clinical Biomechanics / Human Movement Science, and to invite clinicians, engineers, researchers and entrepreneurs working in the field in India to join the initiative. Prof. Rajani was requested to take lead in this matter.

(e) It is also proposed to organise a scientific conference in 18-24 months to reach out to a larger number of professionals working in biomechanics / human movement science, and to facilitate interactions among them. Further, this event could serve as a platform to announce the abovementioned society.

(f) The need for incorporating bio-mechanics in both medical and engineering education was also endorsed. Prof.Prabhat Ranjan mentioned that the time is ripe to integrate all medical disciplines (allopathy, homeopathy, naturopathy, etc.), by having two years of courses common to all disciplines and then branching into specific medical disciplines.

17. **Vote of thanks** was proposed by Prof. Rajani Mullerpatan to the Chair, Co-Chairs, and all participants for enthusiastic and meaningful contributions to the discussions and suggestions.

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Sector-1, Kamothe, Navi Mumbai – 410209

3rd Annual Meet of MGM Centre of Human Movement Science

Date & Time : 11/04/2019, 10.00 a.m. – 1.30 p.m.

Venue : MGM Centre of Human Movement Science, 1st Floor, MGM Superspeciality Hospital, Sanpada

Agenda : A meeting was conducted to present a report on work done at MGM Centre of Human Movement Science followed by discussion related to futuristic plans and remarks from the honored guests and to discuss reconciliation of existing Indian Society of Biomechanics.

Attendees : Dr. Anil Kakodkar **(**Chairman and Secretary, Rajiv Gandhi Institute of Science and Technology), Dr. Shashank Dalvi (Vice-Chancellor, MGM Institute of Health Sciences, Navi Mumbai), Dr. Sudhir Kadam, (Medical Director, MGM Institute of Health Sciences, Navi Mumbai), Prof. Ravi. B (Director, BETiC, IITB), Dr. S.N. Omkar (IISc Banglore), Dr. Sanjay Mishra (Secretary, Department of Science and Technology), Rajani Mullerpatan (Professor-Director, MGM School of Physiotherapy), Dr. Bela Agarwal (Associate Professor, MGM School of Physiotherapy), Dr. Triveni Shetty (Assistant Professor, MGM School of Physiotherapy) and Dr. Juhi Bharnuke (Assistant-Professor, MGM School of Physiotherapy)

Summary of key points : An overview of work done at the centre was presented by Dr. Rajani Mullerpatan supported by Dr.Bela Agarwal and Dr. Triveni Shetty. Dr. Anil Kakodkar expressed his interest in projects related to posture in sedentary workers and people working in different occupations such pilots, IT professionals etc. He suggested that project proposals to be submitted repeatedly to Government funding agencies. The report was well received by the attendees and recommendations regarding future plans were suggested.

Fig 1: Presentation of work done at MGM CHMS

Dr. Rajesh B. Goel
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- The second agenda of the meet was to discuss the reconstitution or establishment of a new Biomechanics society or to revise the current existing society. A Skype meeting was conducted with Dr. S N. Omkar and Dr. Sanjay Mishra for discussing the same. Positive response was received regarding establishment of Society of Biomechanics in India

Fig 2: Interaction of attendees with Dr. Anil Kakodkar

Fig 3: Skype meeting with Dr. S.N Omkar (IISc, Banglore)

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- The meeting concluded with vote of thanks by Dr. Rajani Mullerpatan.

Fig 4: Third Annual Meet of MGM CHMS

Dr. Rajani Mullerpatan
Professor-Director

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