

## CURRICULUM VITAE

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## ACADEMIC AND RESEARCH EXPERIENCE

### Indian Institute of Technology, Hyderabad. Feb 2018-present.

- Associate Professor, Biomedical Engineering dept.

Sl. No.	Degree	University/ Board	Year of passing	Thesis topic/ Subjects studied
1.	M.B.B.S.	M.K.C.G. Medical college, Berhampur, Odisha.	1999	All medical curriculum (Honors in Pharmacology)
2.	M.M.S.T.	Indian Institute of Technology, Kharagpur	2005	Comparison of chondrogenesis in different scaffold structures and culture conditions (Silver medal)
3.	Ph.D.	Division of Bioengineering, National University of Singapore, Singapore.	2010	Tissue engineering of a vascularized bone graft

### Post-doctoral fellowship: Department of Plastic & Hand Surgery, University Hospital of Erlangen, Germany; 2009- Jan 2013.

- *In vitro* analysis of a 3D printed hydroxyapatite- tricalcium phosphate scaffold with osteoblasts and MSCs.
- Analysis of scaffold-cell constructs in static and bioreactor setting.
- *In vivo* analysis of the bone formation in the scaffolds along with osteoblasts and/or BMP-2.
- Working on: Bone tissue-engineered graft using hydroxyapatite-tricalcium phosphate and Bio-active glass scaffolds

No.	Institution Place	Position	From (Date)	To (date)
1.	Indian Institute of Technology, Hyderabad.	Associate Professor	Feb 2018	Contd.
2.	Indian Institute of Technology, Hyderabad.	Asst. Professor	Feb 2013	Feb 2018
3.	University Hospital of Erlangen, Erlangen, Germany.	DFG Post-doctoral fellowship	2009	Jan, 2013
4.	Hindu Rao Hospital, Delhi	Junior Residency	1999	2000

**Ph. D.: Division of Bioengineering, National University of Singapore. 2005-2009.**

- Thesis topic: Tissue engineering of a vascularized bone graft.
- Microsurgical expertise in making arterio-venous loop for a vascularized graft.
- Subcutaneous implantation and analysis of scaffolds.
- Isolation, culture and differentiation studies of Mesenchymal stem cells
- Laboratory analysis of scaffold-cell constructs by Western blot, real time RT-PCR, colorimetric assays.

**M. M. S. T.: School of Medical Science and Technology, Indian Institute of Technology, Kharagpur. 2002-2005.**

- Thesis topic: Comparison of chondrogenesis in different scaffold structures and culture conditions.
- Scaffold fabrication and design by rapid prototyping method.
- Confocal Microscopic and scanning electron microscopic analysis of scaffolds.
- Mechanical testing of scaffold architectures.
- Culture of animal cells: Bone marrow mesenchymal stem cells, chondrocytes.

**RESEARCH INTERESTS**

- Evaluation of biomaterials *in vitro* with different stem cells and their *in vivo* testing in different animal models related to osteogenesis and chondrogenesis.
- Molecular analysis of the process of angiogenesis and osteogenesis.
- Application of biomaterials in an *in vivo* defect model and their evaluation

- 3-D bioprinting using stem cells and biomaterials to fabricate organs *in vitro*

## LIST OF PUBLICATIONS

1. S Sankar, CS Sharma, SN Rath, S Ramakrishna. Electrospun Nanofibers to Mimic Natural Hierarchical Structure of Tissues: Application in Musculoskeletal Regeneration. *Journal of Tissue Engineering and Regenerative Medicine*. 2016.
2. Mahesh K. Sah, **Subha N. Rath**. Soluble Eggshell Membrane: A Natural Protein to Improve the Properties of Biomaterials used for Tissue Engineering Applications. Accepted in *Materials Science and Engineering C*. 2016. doi:10.1016/j.msec.2016.05.005. (Impact factor= 3.088)
3. **Subha N. Rath**, Andreas Brandl, Daniel Hiller, Alexander Hoppe, Uwe Gbureck, Raymund E. Horch, Aldo R. Boccaccini, Ulrich Kneser. Bioactive Copper-doped glass scaffolds can stimulate endothelial cells in co-culture in combination with mesenchymal stem cells. 2014. *PLoS one* 9 (12), e113319. (Impact factor= 3.234)
4. Ulrike Rottensteiner, Bapi Sarker, Dominik Heusinger, Diana Dafinova, **Subha N. Rath**, Justus P. Beier, Ulrich Kneser, Raymund E. Horch, Rainer Detsch, Aldo R. Boccaccini, Andreas Arkudas. In vitro and in vivo biocompatibility of alginate dialdehyde/gelatin hydrogels with and without nanoscaled bioactive glass for bone tissue engineering applications. *Materials* 2014, 7(3), 1957-1974; doi:10.3390/ma7031957. (Impact factor= 2.651)
5. LA Strobel, **Subha N. Rath**, AK Maier, JP Beier, A Arkudas, P Greil, RE Horch, U Kneser. Osteoblasts and Bone Morphogenetic Protein-2 Synergistically Enhance Bone Formation and Homogeneous Bone Distribution in Biomimetic Bicalcium Phosphate Scaffolds. *Journal of Tissue Engineering and Regenerative Medicine*. Volume 8, Issue 3, pages 176–185, March 2014. (Impact factor= 5.199)
6. **Subha N. Rath**, Patcharakamon Nooeaid, Andreas Arkudas, Justus P. Beier, Leonie A. Strobel, Andreas Brandl, Judith A. Roether, Raymund E. Horch, Aldo R. Boccaccini, Ulrich Kneser. Adipose-Derived and Bone Marrow-Derived Mesenchymal Stem Cells Display Different Osteogenic Differentiation Patterns in 3D Bioactive Glass Based Scaffolds. *Journal for Tissue Engineering and Regenerative Medicine*. 2013 Dec 3. doi: 10.1002/term.1849. (Impact factor= 5.199)
7. **Rath SN**, Strobel LA, Arkudas A, Beier JP, Maier AK, Greil P, Horch RE, Kneser U. Osteoinduction and survival of osteoblasts and bone-marrow stromal cells in 3D biphasic calcium phosphate scaffolds under static and dynamic culture conditions. *J Cell Mol Med*. 2012 Feb 3. doi: 10.1111/j.1582-4934.2012.01545.x. (Impact factor= 4.014)
8. **Rath SN**, Arkudas A, Christopher LXF, Olkowski R, Polykandrotis E, Chróścicka A, Bier JP, Horch RE, Huttmacher DW, Kneser U. Development of a Pre-vascularized 3D Composite Scaffold-Hydrogel System Using an Artery-Venous Loop for Tissue Engineering Applications. *Journal of biomaterials applications*. 2012. 27 (3), 277-289 (Impact factor= 2.764)
9. Polykandrotis E.; Arkudas A.; Beier JP; Dragu A; **Rath SN**; Prymachuk G; Schmidt VJ; Lametschwandner A; Horch RE; Kneser U. The impact of VEGF and bFGF on vascular stereomorphology in the context of angiogenic neo-arterialisation after vascular induction. *Journal of Electron Microscopy* 2011. (Impact factor= 1.633)
10. Meng D, **Rath SN**, Mordan N, Salih V, Kneser U, Boccaccini AR. In vitro evaluation of 45S5 Bioglass®-derived glass-ceramic scaffolds coated with carbon nanotubes. *J Biomed Mater Res A*. 2011 Dec;99(3):435-44. (Impact factor= 3.369)
11. Polykandrotis E, Drakotos D, Arkudas A, Prymachuk G, **Rath SN**, Beier JP, Klumpp D, Dragu A, Horch RE, Kneser U. Factors influencing successful outcome in the arteriovenous loop model: a retrospective study of 612 loop operations. *J Reconstr Microsurg*. 2011 Jan;27(1):11-8. (Impact factor= 1.312)
12. **Rath SN**, Prymachuk G, Bleiziffer OA, Lam CX, Arkudas A, Ho ST, Beier JP, Horch RE, Huttmacher DW, Kneser U. Hyaluronan-based heparin-incorporated hydrogels for generation of axially vascularized bioartificial bone tissues: in vitro and in vivo evaluation in a PLDLLA-TCP-PCL-composite system. *Journal of Materials Science: Materials in Medicine*. 2011. 22 (5), 1279-1291. (Impact factor= 2.141)
13. Bleiziffer O, Hammon M, Naschberger E, Lipnik K, Arkudas A, **Rath SN**, Prymachuk G, Beier JP, Stürzl M, Horch RE, Kneser U. Endothelial Progenitor Cells are integrated in newly formed capillaries and alter adjacent fibrovascular tissue after subcutaneous implantation in a fibrin matrix. *Journal of cellular and molecular medicine* 2011. 15 (11), 2452-2461. (Impact factor= 4.014)
14. Fiegel HC, Prymachuk G, **Rath SN**, Bleiziffer O, Beier JP, Bruns H, Kluth D, Metzger R, Horch RE, Till H, Kneser U. Fetal Hepatocyte Transplantation in a Vascularized AV-Loop Transplantation Model in the Rat. *Journal of cellular and molecular medicine* 14 (1-2), 267-274. (Impact factor= 4.014)
15. Bleiziffer O, Horch RE, Hammon M, Arkudas A, Naschberger E, **Rath SN**, Prymachuk G, Beier JP, Hatzopoulos AK, Stürzl M, Kneser U. T17b murine embryonal endothelial progenitor cells can be induced towards both proliferation and differentiation in a fibrin matrix. *J Cell Mol Med*. 2009 May; 13(5):926-35. (Impact factor= 4.014)

16. **Rath SN**, Cohn D, Hutmacher DW. Comparison of chondrogenesis in static and dynamic environments using a SFF designed and fabricated PCL-PEO scaffold. *Virtual and Physical Prototyping*, vol. 3, no. 4, pp. 209–219, 2008.
17. Woodruff MA\*, **Rath SN\***, Susanto E, Haupt LM, Hutmacher DW, Nurcombe V, Cool SM. Sustained release and osteogenic potential of eparin sulfate-doped fibrin glue scaffolds within a rat cranial model. *J Mol Histol.* 38 (5), 425-433. (\* shared first author) (Impact factor= 1.815)
18. Leong DT, Abraham MC, **Rath SN**, Lim TC, Chew FT, Hutmacher DW. Investigating the effects of preinduction on human adipose-derived precursor cells in an athymic rat model. *Differentiation*. 2006 Dec;74(9-10):519-29. (Impact factor= 3.437)
19. Sindhuja DE, Sundeep B, Shahdab A, Parvathi G, **Subha N. Rath**. Osteodifferentiation of Adipose derived Mesenchymal Stem Cells in response to Alternating Current Electric Field. Manuscript under preparation.
20. Shahdab I Almelkar, Praveen Kumar Poola, Ashwani Tandon, **Subha N. Rath**, Renu John. Development of an experimental model of a decellularized kidney scaffold by perfusion mode and analyzing the 3-D extra cellular matrix using quantitative phase imaging. Manuscript under preparation.
21. Shahdab I Almelkar, Sharanya Sankar, Ashwani Tandon, **Subha N. Rath**. Optimization of decellularization protocol of heart valves for tissue engineering application. Manuscript under preparation.
22. Mahesh Kumar Sah, Uday Kiran Roopra, B. B. Panigrahi, **Subha N. Rath**. Ultrasonic-Assisted Extraction of Water Soluble Eggshell Membrane Protein. Manuscript under preparation.

## BOOK CHAPTERS

1. Subha N. Rath, Sharanya sankar. 3D printing for surgeons' practice. 3D printing in medicine. Elsevier publication. Book chapter in preparation.
2. **Subha N. Rath**. 3D printing technology for day-to-day application. Manorama Year Book 2015.

## PATENTS

1. Mahesh K. Sah, Bharat Panigrahi, **Subha N. Rath**. Egg-shell membrane derived proteins for tissue engineering application. Patent in preparation.

## CONFERENCE PUBLICATIONS:

1. **Rath SN**, Martina M, Cohn D, Hutmacher DW. Comparison of chondrogenesis in static and dynamic environment using soft-PCL scaffolds. 8th Annual Tissue Engineering Society International (TESI) Conference & Exposition, October 22-25, 2005, Sanghai, P.R. China.
2. **Rath SN**, Christopher LXF, Hutmacher DW, Kneser U. Development of A Pre-vascularized 3D Composite Scaffold-Hydrogel System Using An Artery-Venous Loop For Tissue Engineering Applications. The International Conference on Biomedical Engineering (ICBME 2008), December 2008, Suntec Singapore International Convention & Exhibition Centre, Singapore.
3. **SN Rath**, G Pryymachuk, A Arkudas, E Polykandrotis, CXF Lam, S Schanbl, J Bier, RE Horsch, DW Hutmacher, U Kneser. Development of a vascularized bone graft by application of BMP-2 in PLDLLA-TCP-PCL-Extracel-HP™ hydrogel composite scaffolds along with arterio-venous (AV) loop. International Congress for Modern Bone Regeneration, Hannover, Germany, 8 - 11 October 2009 (bone-tec 2009).
4. Kneser U, Beier JP, Arkudas A, Polykandrotis E, Bleiziffer O, **Rath SN**, Hutmacher DW, Horch RE. Interaction between 3D scaffolds and blood vessels – Implications for generation of axially vascularised bioartificial tissues. The European Materials Research Society (E-MRS) Fall Meeting Fall Meeting & Exhibit. Warsaw University of Technology, Warsaw (Poland), September, 2008.
5. **Rath SN**, Strobel LA, Arkudas A, Beier JP, Maier AK, Greil P, Horch RE, Kneser U. Osteoblasts and bone-marrow stromal cells in 3D biphasic calcium phosphate scaffolds: the effect of bioreactor on cell survival and differentiation. TERMIS-North America Meeting 2011. December 11 - 14, 2011.
6. Cell-based therapy of bone defects in wounds by MSC-seeded in 3D scaffolds: the success depends on MSC source. **Subha N. Rath**, Patcharakamon Nooeaid, Judith A. Roether, Raymund E. Horch, Aldo R. Boccaccini, Ulrich Kneser. Wound Care Con 2013. 2nd International and 7th National Annual conference of Society for wound care and research, Pondicherry, India. ISBN No. 978-81-95686-3-0.
7. Osteogenic differentiation of MSCs in 3D Bioglass-based scaffolds depends on their source of origin. **Subha N. Rath**, Patcharakamon Nooeaid, Judith A. Roether, Raymund E. Horch, Aldo R. Boccaccini, Ulrich Kneser. TERMIS-asia pacific 2013, Sanghai, China.
8. Endothelial cell stimulation in an in-vitro co-culture model with mesenchymal stem cells by Copper doped bioactive glass based scaffolds. **Subha N. Rath**, Andreas Brandl, Daniel Hiller, Alexander Hoppe, Uwe Gbureck, Raymund Horch, Aldo R. Boccaccini, Ulrich Kneser. BIT's 8th World Congress of Regenerative Medicine & Stem Cell 2015- Shanghai. Nov 18-20, 2015.

9. 3D Bioprinting for tissue engineering application. Sindhuja D.E., **Subha N. Rath**, Falguni Pati, pp.33-36. ICDF2016 Proceedings of 2nd International Conference on Digital Fabrication 2016 Tokyo, March 3-5.
10. A Review of Hydrogels in Droplet based Bio-Fabrication Techniques. Shahid Ansari, Mahendra D. Date, **Subha N. Rath** and Suryakumar S, pp.37-41. ICDF2016 Proceedings of 2nd International Conference on Digital Fabrication 2016 Tokyo, March 3-5.

### **ACADEMIC ACHIEVEMENTS:**

1. DFG (Deutsche Forschungsgemeinschaft) post-doctoral fellowship (2009-2012)
2. NUS, Singapore research scholarship (2005-2009)
3. Young scientific reviewer for BIOMATERIALS
4. SILVER MEDAL in IIT, Kharagpur.
5. Honours in Pharmacology.
6. Winner of State level Mathematics Olympiad.
7. 6<sup>th</sup> rank in All India Entrance for MMST conducted by IIT Kharagpur.

### **MEMBER OF FOLLOWING SOCIETIES:**

1. Tissue engineering and regenerative medicine international society (TERMIS)
2. Society for tissue engineering and regenerative medicine (India) (STERMI)
3. Society for Biomaterials and Artificial Organs (India) (SBAO)