Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA20126

Grantee name: Akash Bachhuka

Details of the STSM

Title: Synergistic effect of tailor-engineered nanotopography and chemistry on modulating osteointegration of dental implants

Start and end date: 31/07/2023 to 29/08/2023

Description of the work carried out during the STSM

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

(max. 500 words)

During STSM, I performed experiments to better understand the interplay between platelets and plasma-coated copolymer surfaces, emphasizing their potential implications for osteointegration in dental implants. While my initial research plan focused on dental implant osseointegration, I took the opportunity to explore platelet behavior on modified surfaces, recognizing their crucial role in the process of bone integration.

Activities Undertaken:

1. *Surface Preparation and Modification:*

I prepared plasma-coated copolymer surfaces featuring diverse chemical compositions. These varied surfaces were crafted to simulate the conditions that dental implants might encounter within the body.

2. *Platelet Isolation and Adhesion Assays:*

I isolated platelets and introduced them to the modified surfaces by employing blood samples. I executed platelet adhesion assays to quantitatively assess the adherence of platelets to each distinct surface.

3. *Platelet Activation Analysis:*

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

In order to gain insight into the influence of plasma-coated copolymer surfaces on platelet behavior, I analyzed platelet activation. This encompassed evaluating the release of specific biomarkers that indicate platelet activation status.

4. *Data Collection and Analysis:*

The data collected from the experiments underwent rigorous statistical analysis. By comparing platelet adhesion and activation responses across various surfaces, I obtained valuable insights into the potential effects of surface chemistry on osteointegration processes.

Deviations from the Initial Working Plan:

While the original intent was to delve into the interactions between bone cells and modified dental implant surfaces, my focus shifted toward understanding platelet behavior on plasma-coated copolymer surfaces. This deviation was underpinned by the recognition that platelets are instrumental in blood clotting and facilitating the biological processes essential for successful osseointegration.

This deviation provided an opportunity to contribute to the broader understanding of biomaterial interactions within the context of osteointegration. The insights gained are relevant to the broader field of biomaterials and their application in enhancing the performance of medical implants.

Description of the STSM main achievements and planned follow-up activities

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

(max. 500 words)

Assessment of Achieved Goals and Expected Outcomes:

STSM was initially conceived with the goal of investigating the influence of surface chemistry and nanotopography on dental implant osseointegration. However, a deviation from the original plan led to a shift in focus toward exploring platelet interactions with plasma-coated copolymer surfaces and their potential implications for osteointegration. This shift proved to be both fruitful and relevant to the broader context of biomaterial implants.

Achievement of Goals:

Understanding Platelet-Surface Interactions:

Our primary aim was to explore the influence of surface modifications on platelet behavior. This goal was successfully achieved through a series of experiments, including platelet adhesion assays and activation analyses.

Contributions to Action Objectives:

The STSM contributed significantly to the objectives of the collaborative research project by expanding our knowledge of biomaterial interactions. Specifically, it enhanced our understanding of the role of platelets in osteointegration, a critical aspect of dental implant success. This knowledge aligns with the broader goals of improving implant biocompatibility and patient outcomes.

Expected Outcomes:

Improved Understanding of Platelet-Surface Interactions:

The STSM yielded valuable data on how plasma-coated copolymer surfaces influence platelet adhesion and activation. These outcomes provide a foundation for future research into enhancing the biocompatibility of medical implants.

Potential for Enhanced Dental Implant Biocompatibility:

Insights gained from this study may pave the way for the development of dental implant surfaces that promote more efficient and robust osteointegration. This has the potential to improve the long-term success of dental implants and the quality of life for patients.

Deliverables and Publications:

As a direct result of the STSM, several key deliverables and potential publications have emerged:

Research Data and Findings:

The STSM generated a substantial dataset, including quantifiable measurements of platelet adhesion and activation on various surfaces. These findings are currently being analyzed and prepared for publication in peer-reviewed journals.

Scientific Papers:

It is anticipated that the insights gained from this research will lead to the publication of scientific papers that will contribute to the field of biomaterial implants.

Agreed Plans for Future Follow-Up Collaborations:

The STSM has paved the way for future collaborations and research endeavors:

Collaborative Research Projects:

Building upon the knowledge and data generated during the STSM, we are actively planning collaborative research projects within the Action Network. The coating technology under investigation exhibits surface-independent applicability, offering a unique opportunity to delve into the synergistic effects of these coatings when combined with diverse nanotopographies. These collaborative projects will significantly contribute to our comprehensive understanding of how these coatings impact various biological activities related to biomaterial implants.

Continued Exchange of Expertise:

Future collaborations will involve ongoing exchanges of expertise, data, and insights among researchers within the Action network. This collective effort will contribute to advancing the state of the art in biomaterial implants.

In conclusion, while the STSM deviated from its initial focus on dental implant osseointegration, it successfully achieved its goals related to understanding platelet-surface interactions and their implications for osteointegration.