In Situ Raman Analysis of Resorbable and Drug Loaded Implants

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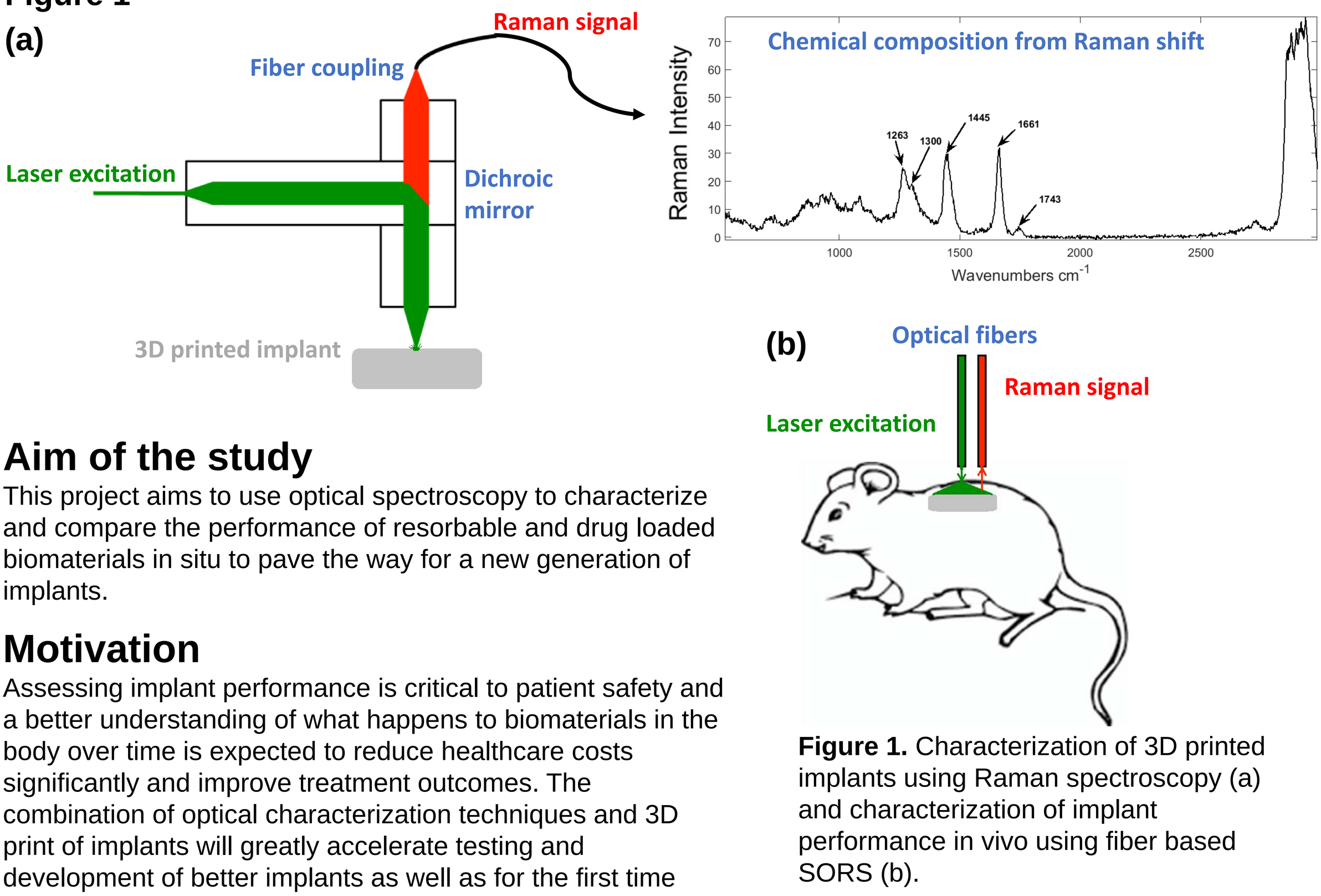
Background

Bone trauma is a common condition treated at most hospitals. The use of implants are often a vital part of the treatment. In some cases permanent implants may be required to replace pieces of resected or destroyed bone that for example may not be able to heal on its own [1]. Current implants consist of non-resorbable materials, grafts or graft substitutes. Non-resorbable materials which do not degrade in the body requires frequent removal or revision surgeries due to wear, infection, inflammation and growth in young patients [2]. Synthetic degradable materials along with drug loaded implants may solve a number of problems associated with conventional implants and are therefore of great interest [3]. A major impediment to the development of resorbable and drug loaded implants is the lack of methods that allows for time resolved study of material degradation, tissue regeneration and drug release in individual implants.

Figure 1



Aim of the study

This project aims to use optical spectroscopy to characterize and compare the performance of resorbable and drug loaded biomaterials in situ to pave the way for a new generation of implants.

Motivation

Assessing implant performance is critical to patient safety and a better understanding of what happens to biomaterials in the body over time is expected to reduce healthcare costs significantly and improve treatment outcomes. The combination of optical characterization techniques and 3D print of implants will greatly accelerate testing and development of better implants as well as for the first time allow for in vivo studies of resorption, release and regeneration rates.

Methods

- **3D print resorbable and drug loaded implants using robocasting**
- **In vitro tests of implants with mesenchymal stem cell culture**
- **Characterize chemical composition of implants and native tissue using Raman spectroscopy**
- **Time resolved in vivo tests of implants in mice**

Figure 1. Characterization of 3D printed implants using Raman spectroscopy (a) and characterization of implant performance in vivo using fiber based SORS (b).

References

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[2] Rachit Agarwal and Andrés J. García, “Biomaterial strategies for engineering implants for enhanced osseointegration and bone repair ☆,” *Adv. Drug Deliv. Rev.*, vol. 94, pp. 53–62, 2015.

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