

Form B-2  
(FY2022)  
Must be typed

Date (日付) 31/10/2022

(Date/Month/Year: 日/月/年)

**Activity Report -Science Dialogue Program-**  
(サイエンス・ダイアログ事業 実施報告書)

- Fellow's name (講師氏名): KARAN GULATI (ID No. P20710)

- Name and title of the lecture assistant (講義補助者の職・氏名)  
Mr. Osamu Sakai (Teacher from Katsuyama Senior High School)

- Participating school (学校名): Katsuyama Senior High School, Katsuyama-City, Fukui

- Date (実施日時): 29/10/2022  
(Date/Month/Year: 日/月/年)

- Lecture title (講義題目):  
Nano-Engineered Dental Implants

- Lecture format (講義形式):  
◆  **Onsite** ・  Online (Please choose one.)(対面 ・ オンライン(どちらか選択ください。))  
◆ Lecture time (講義時間) 55 min (分), Q&A time (質疑応答時間) 15 min (分)  
◆ Lecture style (ex.: **used projector**, conducted experiments)  
(講義方法 (例: プロジェクター使用による講義、実験・実習の有無など))  
Lecture delivered in person using computer and projector.

- Lecture summary (講義概要): Please summarize your lecture within 200-500 words.

**What is a dental implant?**

Whenever there is damage to a tooth due to disease or accident that cannot be treated or a complete loss of a tooth, the tooth is completely removed (from roots), and a dental implant is placed. Via surgery, a hole is drilled into the bone, followed by the insertion of a dental implant. Dental implants are made up of metals such as titanium and zirconium.

**Integration and infection**

The implant is a foreign body that must integrate or form a bond with the bone (integration). In the oral environment, disease-causing bacteria are always present. If the bacteria reaches the implant site that is poorly integrated, bacteria can attach to the implant and cause infection. Poor

integration and infection are the primary reasons for implant failure. This is common in patients with ongoing conditions (see below). An implant failure means the implant must be removed via surgery and discarded, and the implant site must be thoroughly decontaminated (or cleaned). Then a new implant must be placed. This costs a lot of money and causes inconvenience to the patients.

### **Dental implant failure – compromised patient conditions**

Around 5-10% of all dental implants can fail due to a variety of reasons, as summarized below (for smoking patients >20% failure rates are seen):

#### **Race to invade implant site**

Good cells (bone cells and soft-tissue/gum cells) and bad cells (bacteria) always surround the implant. These cells race to invade the implant, and dependent on the winner, integration (good cells win) or infection (bad cells win) can happen.

#### **What can be done to improve implant success rates?**

The activity of good cells must be increased (toward integration), while the activity of bad cells (bacteria) must be reduced to prevent infection. Every implant's ultimate goal is quick integration (good cells win the race) and preventing bacterial infection (bad cells lose the race). Dental implants are made of metals; these surfaces do not promote good cell activity or prevent bad cell activity. Especially in compromised patient conditions, there is a high chance of poor integration and bacterial infection. Surface modification of dental implants is performed to increase integration and prevent infection. When performed in the nanoscale (1-100 nanometers or nm), this implant modification is called implant nano-engineering.

#### **Implant nano-engineering**

Using a technique called electrochemical anodisation (EA) surface of titanium and zirconium dental implants can be modified to fabricate tiny nanostructures (tubes or pores). These nanostructures increase the activity of good cells such that integration happens timely. Further, these nanostructures are like empty cylinders and can be loaded with antibacterial drugs to target infection (kill bacteria). Hence, nano-engineered dental implants can improve long-term implant success (even in compromised patient conditions) by ensuring the timely formation of integration and preventing bacterial infection

#### **Lecture title: Nano-Engineered Dental Implants**

My lecture discussed all the topics mentioned above, focusing on how implant nano-engineering works to improve implant success.

◆Other noteworthy information (その他特筆すべき事項):

## SD

※弊会記入欄

I would like to thank JSPS Science Dialogue Program for giving me this opportunity. The organizer at the school (Mr. Osamu Sakai) was very kind and helpful. He picked me up from the nearby station and also dropped me back after the lecture. The students were very interested and actively participated in the lecture.

I would be more than happy to participate in a similar program to deliver lectures to high school students.

- Impressions and comments from the lecture assistant (講義補助者の方から、本事業に対する意見・感想等がありましたら、お願いいたします。):

As mentioned above Mr. Osamu was very helpful and organized the lecture.