

大阪大学臨床医工学融合研究教育センター(MEI)センター  
グローバルCOE「医・工・情報学の融合による予測医学基盤創成」  
—*in silico medicine* を指向したオープンプラットフォームの構築—

グローバルCOEプログラム

■ 若手研究者短期留学・滞在 ■

- 氏名 ■ Manveen Singh Toor
- 所属 ■ National University of Singapore
- 身分 ■ Fulltime Masters Student
- 滞在期間 ■ 6 日間 (2011/12/4~12/10)
- 受入先 ■ 大学院歯学研究科 教授 高田 健治

■ 報告 ■

**Purpose:**

The purpose of this research trip was to collaborate with the Dept of Orthodontics and Dentofacial Orthopedics at Osaka University on an area of research with Cone Beam CT imaging of the dento-facial structures. This collaboration involved the collection of CBCT images to be used for three research projects involving:

- 1) The analysis of the structural change observed in the inclination of the incisors and dentoalveolar housing, as well as, analysis of the change of thickness of the labial and palatal surface of the dentoalveolus from the root apex of the incisors after orthodontic retraction of the maxillary incisors.
- 2) Identification of the relation between the impaction of maxillary canines and root resorption of the maxillary incisors to the surrounding anatomical structures including, the maxillary sinus, the nasal cavity, and the floor of the nasal cavity.
- 3) The sensitivity and specificity of using conebeam CTs to detect ankylosis of

impacted teeth.

### **Objectives:**

- 1) To collect conebeam CT data and clinical data related to the three research projects stated above.
- 2) To discuss rationale and clinical relevance of proposed research projects.
- 3) To discuss methodology and approach to analyzing subject data.

### **Activities and Achievements:**

#### 1) Data collection

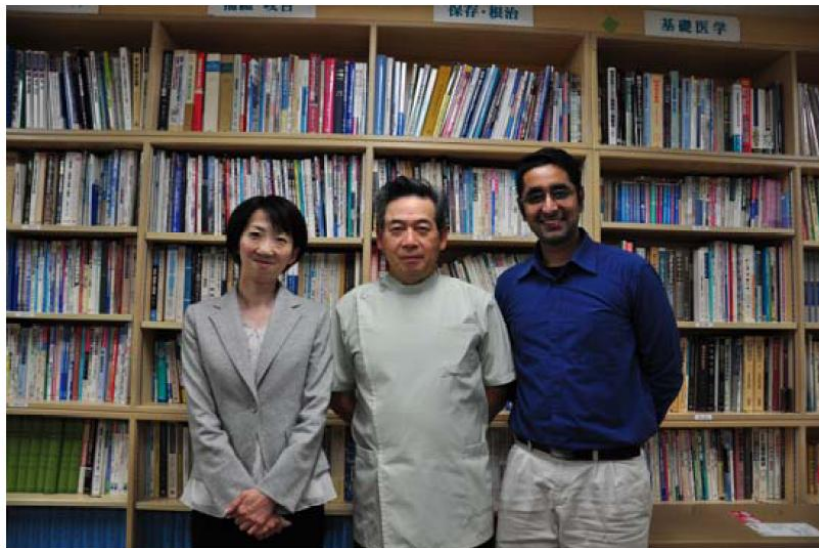
The process of collecting the conebeam CT data and clinical data was carried out from Monday (11/12/5) to Friday (11/12/9). On Monday, I was introduced to Clinical Professor Dr Kanomi and was then brought to his dental practice in Himeji where conebeam CT data, as well as OPT and clinical data was collected on patients with impacted canines. This data includes patients of difference age range and treated with different treatment modalities such as, extraction, orthodontic traction of impacted teeth, RPE (rapid palatal expansion) and non-intervention (or observation). The clinical data was recorded from patient records and stated the basic information of patient (age/sex), teeth that were impacted, as well as treatment modality and treatment outcome. Digital scans of OPT's of these patients were also collected where available.

The above data will be relevant to two of the research projects mentioned above i.e. 1) Identification of the relation between the impaction of maxillary canines and root resorption of the maxillary incisors to the surrounding anatomical structures including, the maxillary sinus, the nasal cavity, and the floor of the nasal cavity. 2) The sensitivity and specificity of using conbeam CTs to detect ankylosis of impacted teeth.

For the research project involving “the analysis of the structural change observed in the inclination of the incisors and dentoalveolar housing, as well as,

analysis of the change of thickness of the labial and palatal surface of the dentoalveolus from the root apex of the incisors after orthodontic retraction of the maxillary incisors."Cone beam CT data of Dr Kanomi's patients were collected from the Dental School of the University of Osaka with the kind assistance of Professor Takada and Dr. Tome. Additional cone beam CT data was also collected from Dr. Kanomi's dental practice in Himeji.

All necessary data was successfully collected. A total of 231 impacted canine cases were collected. In addition, clinical data and scans of OPT (where available) were also recorded. 120 cases involving CBCT data on mini-implant and mini-plate usage in the treatment of class I and II malocclusions was successfully collected to analyze the structural change when retracting maxillary incisors.



Clinical Professor Dr Kanomi, Dr Shintaka, and myself at Dr Kanomi's dental center after collection of CBCT data.

## 2) Discussion of research projects

Monday, 5th Dec, Clinical Professor Dr Kanomi presented his previous research and observations regarding his treatment of more than 300 impacted canine cases. From his observations, there seems to be a much higher prevalence of

buccally impacted maxillary canines compared to palatally impacted ones in the Japanese population. There is also a high incidence of root resorption of lateral and central incisors that are in close proximity to these impacted canines. A series of cases were presented with conebeam CT data to visualize the impacted canines and surrounding structures.

During the course of the discussion, three observational points were raised that would need further investigation.

- a) Impaction of canines may be due to the presence of narrow maxillary arches in these patients.
- b) There is a possible correlation between direction of displacement of these impacted canines to the surrounding anatomical structures, such as, the maxillary sinus, floor and lateral walls of the nasal cavity, and the neighboring teeth.
- c) There was increased size of the dental follicles in cases where root resorption was present.

It was also suggested through the course of the discussion that canine impaction may be a growth-associated problem related to variations in size, structure and speed of growth of the surrounding structures.

This discussion was beneficial as we were able to determine the direction in which to approach the research on impacted canines. The approach to this topic may be two-fold:

- a) To assess the link between maxillary canine impaction and surrounding anatomical structures.
- b) To determine anatomical markers or predictors to categorize the type of impaction, its severity, and possible risk of root resorption to neighboring teeth.

Discussions on the research project regarding “the analysis of the structural

change observed in the inclination of the incisors and dentoalveolar housing, as well as, analysis of the change of thickness of the labial and palatal surface of the dentoalveolus from the root apex of the incisors after orthodontic retraction of the maxillary incisors” were held between Wednesday (7th Dec) and Thursday (8th Dec).

The discussion focused on the objectives of the study, the parameters which needed to be looked at and the methodology involved.

The factors to be assessed in this study would be

- a) Change in incisor inclination
- b) Change in dentoalveolar housing inclination
- c) Change in thickness of bone on the buccal and palatal surface of the root apex of the incisors.

Very early in the discussion, it was noted that the traditional methods of linear measurement as on lateral cephalometry, would be insufficient and inaccurate when trying to comprehend, measure, and present 3 dimensional data. A reference plane that was i) stable, ii) reproducible, iii) applicable, needed to be established. Through visualization of the conebeam CT data using Imagnosis and Osirix software, it was proposed to use a constructed plane with points passing through the left and right zygomatic foramen, and the middle of the frontonasal suture. This plane could then be used as a stable reference to measure the change in incisor and dentoalveolar housing inclination. However, the variance in identification of this plane will be examined before using it as a reference plane.

To measure the bone thickness of the buccal and palatal surfaces of the dentoalveolus, a cross section of the incisors would be used with the y-axis corresponding to the long axis of the tooth and the z-axis (depth or thickness) as

an orthogonal plane derived from the OsiriX software. Thickness of bone can then be measured using the OsiriX software.



Professor Takada and A/Prof Foong determining possible reference planes



Assessing feasibility of OsiriX software as a visualization and measuring tool.

These discussions succeeded in defining the parameters for study and to define the possible references planes that could be used when measuring these parameters. Methodology for measurement was also established In short, the purpose and objectives of this research trip were achieved admirably.

**Follow up:**

The following are the noted actions that will be carried out on return to Singapore:

- a) Revision of the MDS these protocols based on the new information and direction gained from Osaka
- b) Continual joint analysis of the cone beam CT and clinical data between the teams from NUS and Osaka University
- c) Establish conclusions and discussion of research based on results of data analysis
- d) Compilation of analytical data, results, conclusions, and discussion
- e) Presentation of data international conferences, submission of manuscripts for publication in internationally-refereed journals, and completion of MDS theses. Target for completion of (e) by end Dec 2012.