



TOHOKU
UNIVERSITY

The road from Interface Oral Health Science at
Tohoku University Graduate School of Dentistry to
Oral Health Scientist and Oral Health Care Professional

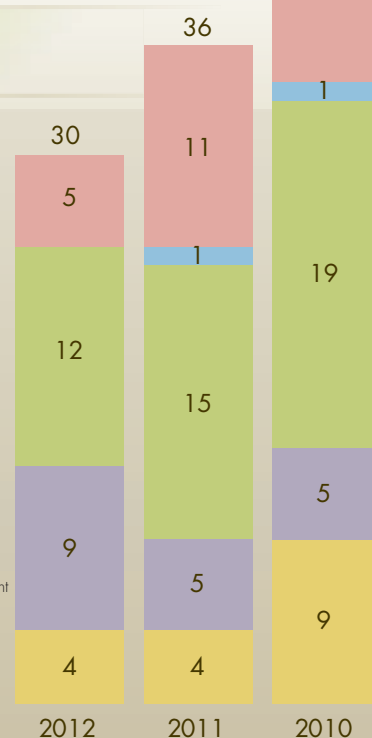
Tohoku University Graduate School of Dentistry 2014

Master's
Course

Doctoral
Course

Graduates from
Doctoral Course
47

Career path after graduation



- Others
- Member of Japan Society for Promotion of Science
- Clinical dentists (including independent and hired)
- Tohoku University Hospital medical staff
- Professors

Tohoku University Graduate School of Dentistry Commences the Next Generation of Dentistry, Dental Care and Oral Health

Dean,
Tohoku University
Graduate School of Dentistry



Keiichi Sasaki

The Graduate School of Dentistry's mission is to train international leaders and highly specialized professionals of dentistry, dental care and oral health for the next generation, who have a research-oriented outlook and a scientific mind, by utilizing characteristic programs such as the Interface Oral Health Science program and the Master's course (Japan's first master's course in dentistry). Here the education and research systems of various fields converge, utilizing the facilities of Tohoku University, one of the world's leading comprehensive universities.

Seiryō-machi, where the campus is located, is famous as the home of Masamune Date, a *Daimyo*, or powerful local lord. At the foot of Kitayama Gozan Terrace in the north part of an old urban area in the city of Sendai is the temple of Oshū.

The Graduate School of Dentistry of Tohoku University, together with the School of Dentistry, the Graduate School/School of Medicine, the Institute of Development, Aging and Cancer, and Tohoku University Hospital, form one of the largest centers for medical/dental research, education and advanced medicine in Eastern Japan.

The Graduate School of Dentistry was established on the Seiryō Campus in 1972, seven years after the School of Dentistry opened. Since then, in accordance with the founding principles of Tohoku University – “to be research-oriented” “an open-door policy” and “emphasis on practical science” – the Graduate School of Dentistry has been involved in training dentists and researchers with a global perspective who will play a leading role in the broader field of dentistry, from basic research to clinical practice and oral health.

In 2000, in response to the educational policy of placing an increased emphasis on graduate schools, the Graduate School of Dentistry became an independent graduate school in Tohoku University and its new history began.

As a pioneer of independent graduate-level education across the country, the Graduate School of Dentistry has been involved in a wide variety of research and educational projects to fulfill these expectations.

The Seiryō Campus suffered severe damage from the Great East Japan Earthquake of March 11, 2011. However the education and research environment has been restored and the progress of reconstruction has been remarkable. The facilities are improving, and will soon be even better than before.

In 2002, we proposed a new concept to promote the reform of the existing dental research and education system, which we call “Interface Oral Health Science.” At present, we are conducting a number of studies based on the “interface” concept, in a convergence of various fields. These studies are being conducted in collaboration with other departments of the university and research facilities around Japan and overseas, and we have made remarkable progress.

In 2004, to expand the range of dental medicine and oral health, as well as to “open the door” to dental research and education, we established the Graduate School of Dentistry Master's course, the only master's course in dental medicine in Japan. Currently, people who have a wide range of disciplines and a variety of careers, such as dental assistants, medical assistants, engineers, nutritionists, health and welfare administrators, and medical personnel are studying in our Master's program.

Also, significant progress has been attained in education and research with international cooperation with world-leading research schools, including Peking University and Sichuan University Tianjin Medical University, in China and Seoul University and the University of Chonnam in South Korea. We are investigating establishing standards of dental education in East Asia, and are currently organizing a double degree program in which students can receive academic degrees from two universities.

Dental education at the Graduate School of Dentistry is supported by scientific excellence and a global perspective, which have been developed through advanced research activities in accordance with our “research-oriented” policy.

Furthermore, it has been developed into a clinical application as a “practical science.” The Graduate School of Dentistry aims to train dentists and researchers with an inquiring mind and a scientific perspective who will play a central and leading role in dental research, education and practice, as well as medical administration. We are looking forward to welcoming competent, qualified and promising students to gather in Sendai, who are motivated to develop the next generation of dentistry and dental care under the rigorous school spirit of Tohoku University.

Milestones in the history of modern dental medicine and Japanese dental medicine

- 1723** ■ Pierre Fauchard (known the father of modern dental medicine) announces "Le Chirurgien Dentist"
- 1728** ■ Fauchard makes full maxillary dentures
- 1840** ■ First modern dental medicine school in the world, Baltimore School of Dentistry, established in U.S.
- 1844** ■ Tooth extraction conducted under general anesthesia using nitrous oxide
- 1846** ■ Oral surgery conducted using ether anesthesia in the U.S.
- 1860** ■ American dentist William Clark Eastlake opens dental clinic in Yokohama. American style dental medicine becomes available in Japan.
- 1876** ■ Mizuhoya imports dental equipment from U.S. to Japan. Production of dental equipment starts in Japan.
- 1878** ■ Kisai Takayama goes to the U.S. to study dental medicine at his own expense, returns to Japan after passing exam to practice medicine as a dentist.
- 1881** ■ Takayama publishes first dental technical book in Japan, "Hoshishinron"
- 1883** ■ Medical practice test rules established and dental medicine becomes specialized field. American dentist Willoughby D. Miller announces "Miller's chemico-parasitic theory."
- 1888** ■ First school of dental medicine in Japan, Tokyo College of Dental Medicine, established (closed the next year).
- 1890** ■ Takayama School of Dentistry established. (In 1900, changes name to Tokyo College of Dentists; in 1946 restructured into Tokyo Dental College.)
- 1891** ■ Fact that dental plaque causes tooth decay discovered in U.S.
- 1893** ■ Dental Practitioners Association established (in 1926, changes name to Japan Dental Association).
- 1902** ■ Japan Association for Dental Science established.
- 1903** ■ School of Dentistry at School of Medicine, University of Tokyo established.
- 1906** ■ Dental Practitioners Law instituted.
- 1911** ■ Dental College established.
- 1916** ■ Dental Practitioners Law revised to restrict doctors from practicing dentistry.
- 1928** ■ Cavity Prevention Day instituted. Tokyo High School of Dental Medicine (currently Tokyo Medical and Dental University) established. Dentist training by national institutions in Japan starts.
- 1946** ■ Dental Education Council begun under the General Headquarters orders.
- 1947** ■ Dentist National Examination begins.
- 1948** ■ Dental Education Standards Draft passed.

History of the Graduate School of Dentistry, School of Dentistry

- 1965** ■ Tohoku University School of Dentistry established, advocating the philosophies of "Training dentists who can think," "One mouth is a unit," and "Holistic dentistry."
- 1967** ■ Tohoku University Dental Hospital opens.
- 1972** ■ Tohoku University Graduate School of Dentistry established.
- 1975** ■ Dental Technicians School established.
- 1993** ■ Prof. Emeritus Hajime Yamamoto awarded Japan Imperial Prize for "Research into applications related to prevention of tooth decay by laser irradiation."
- 2000** ■ Tohoku University Graduate School of Dentistry, responding to the government's educational policy of emphasizing graduate schools by educating students with inquiring minds and scientific perspective who can be leaders in dental research.
- 2002** ■ Interface Oral Health Science concept proposed by Tohoku University Graduate School of Dentistry.
- 2003** ■ Organizational integration of Tohoku University Dental Hospital and University Hospital. Tohoku University Hospital opens.
- 2004** ■ Graduate School of Dentistry establishes first Master's course in dentistry in Japan. Graduate School of Dentistry starts conducting special education in oral science for people other than those in the medical and dental field.
- 2005** ■ First International Symposium on Interface Oral Health Science held.
- 2007** ■ Tohoku University Dental Hospital and Medical Center renamed, beds and operating rooms moved to new location. "Living body biomaterial high-performance interface science project" begins, sponsored by Ministry of Education, Culture, Sports, Science and Technology.
- 2008** ■ Implant outpatients accepted at Dental Medical Center of Tohoku University Hospital.
- 2009** ■ Renovation of Lecture Building of Graduate School of Dentistry completed.
- 2010** ■ Prof. Emeritus Shobu Hinuma awarded Order of Culture. Medical Dental Center outpatient clinic transferred and integrated as Dental Department of Tohoku University Hospital.
- 2012** ■ Renovation of Clinical Research Building, Graduate School of Dentistry completed.

Greetings from the Dean

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The Stomatognathic System – Be an ‘Oral Scientist’ Rather Than a ‘Dentist’

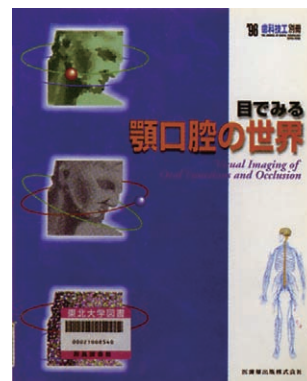
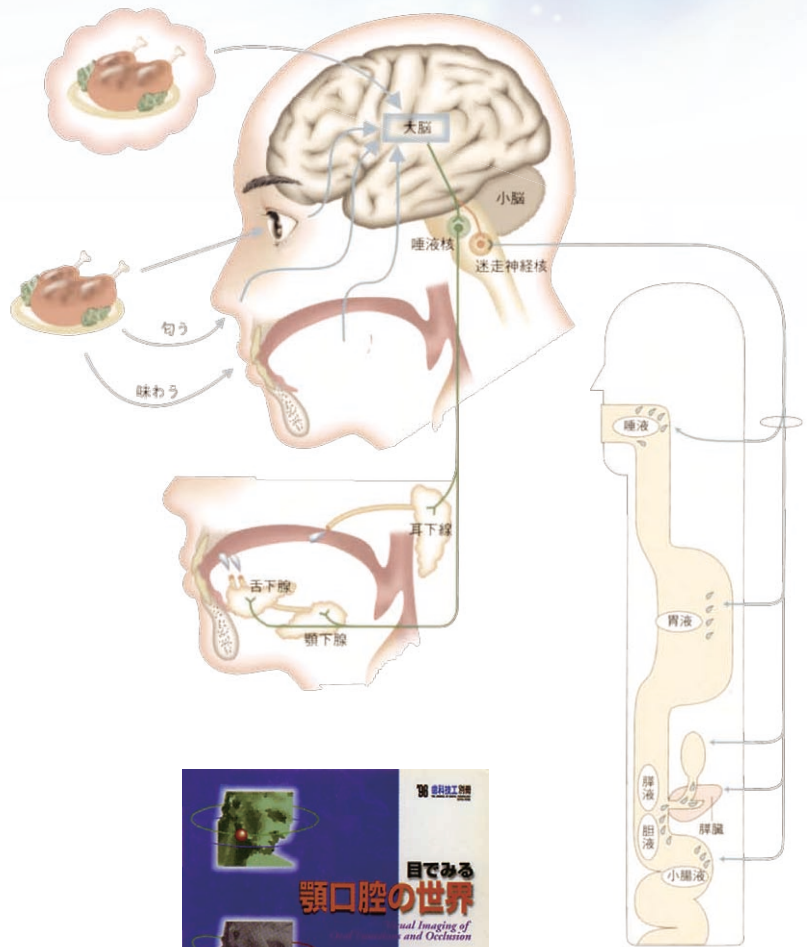
According to the Dental Practitioners Act, dentists should take responsibility to support people so that they can lead a healthy life through dental care and oral health guidance, which will result in the improvement and promotion of public health. Therefore, the dentists’ social mission is not only to prevent oral-related diseases such as cavities and periodontal disease, but also to lead people towards a healthy lifestyle. Good oral health allows us to enjoy our meals and smile with confidence. In other words, the responsibility of the dentist is not only the treatment of oral diseases but also to ensure that people have a mouth that can “talk, smile with confidence and truly enjoy meals”, by promising better quality of life from the very young to the elderly. At Tohoku University School of Dentistry, we do not educate plain dentists but ‘Oral Scientists’.

What is Oral Science? Oral Science is part of Life-Science, which seeks to contribute to the people’s happiness and high standard of quality of life through a thorough understanding of the importance of oral health. The clinical segment includes an intense study of major oral diseases, namely: dental caries, gum disease, malocclusion, temporomandibular joint disease, and also oral cancer, fracture injuries due to traffic accidents, congenital conditions such as cleft lip and palate, jaw deformities, and various diseases of the jaw and facial area around the mouth. These diseases impair the function of the oral cavity, jaw and facial area. In some cases these diseases may affect other parts of the body, or in some cases the whole body, and vice versa.

To understand Oral Science, you need a thorough understanding of the stomatognathic system. The philosophy, “Control of the stomatognathic system,” is presented at the beginning of the book “The Oral and Maxillofacial World Through Your Eyes” (Ishiyaku Publishers, 1996).

The living body ingests energy from the outside world in order to maintain life and movement. The stomatognathic system functions as the organ for this purpose. In addition, it has a social function of expressing emotion and feelings of pressure and discomfort. These functions of the stomatognathic system are controlled by the central nervous system via the peripheral sensory and motor nervous subsystems. Artificial manufactured parts used in the reconstruction of the stomatognathic system are harmonized with the living body and brought to “life.” Clinical dentistry is carried out based on these realities.

Therefore, in order to cultivate Oral Science, it is necessary to learn not only about the oral cavity, jaw and mouth area, but also the organization and functions of the human body. These include the various life phenomena which support the organization and function of the human body, and the origins of the disease. On the basis of a wide-ranging basic medical knowledge and techniques, providing dental care is required to master special and unique knowledge and techniques that Oral Science offers.



The writing team from Tohoku University Graduate School of Dentistry at that time was made up of the following people. Yoshinori Hattori, Tetsuo Kawada, Masahiko Kikuchi, Keiichi Sasaki, Tomoaki Sato, Yoshizumi Tamazawa, and Makoto Watanabe (honorary omitted; in alphabetical order).

International joint education to establish standards of dental education in East Asia

We have launched a multi-modal dentistry innovation program. This is a graduate school educational project aimed at establishing a setup for accepting overseas students, focusing on the Joint Graduate School Education system through collaboration with some of East Asia's core universities. Another of its goals is to construct an "East Asian standard" through dentistry innovations with "global knowledge" and "integrated knowledge" as the keywords and to enhance the level of dentistry and dental treatment in Japan and East Asia.

Specifically, we will step up educational and research collaborations by focusing on developing and implementing the Double-Degree Program (DD Program) with influential dentistry graduate schools in China and South Korea. Under this program, a graduate school student will be registered at two university graduate schools, receive education from the faculty of both schools, and earn academic degrees from both schools if he or she meets the requirements. By means of this setup, we aim to establish dentistry and dental treatment based on a foundation common to all of East Asia (the "East Asian standard"), and realize dental innovation.

While still enrolled in graduate school, participants in the DD Program study abroad at the partner university for a set period of time, and carry out joint research. An agreement has been made with several universities, including Peking University and Sichuan University in China, and Chonnam National University in South Korea. These schools have already begun accepting graduate school students from abroad.



A memorandum on student exchanges was concluded with Chonnam National University Graduate School of Dentistry (February 3, 2013).



Sydney-Tohoku Dental Symposium (2013.1.18-19)

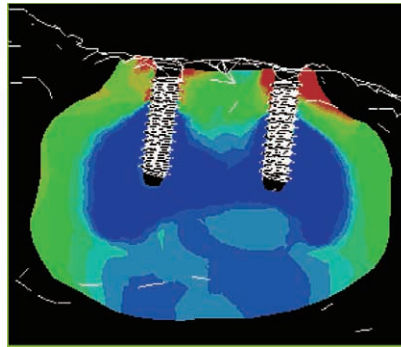
Example of Interdisciplinary Cooperation

The Living Body – Creation of Non-biological Intelligent Interfaces

In dental treatment, biomaterials are widely used as implant materials, including titanium and calcium phosphate-based materials which are used for bone regeneration.

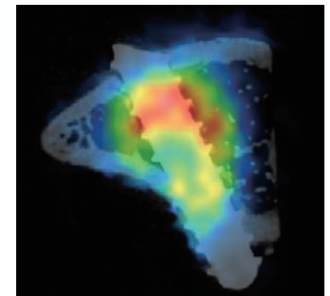
The Graduate School of Dentistry is committed to the development of various new biomaterials, in collaboration with, for example, the Institute for Materials Research, University of Tokyo. Furthermore, in order to increase the performance of interfaces between biomaterials and the living body, cooperative research has been conducted with Tohoku University Graduate School of Engineering and Graduate School of Biomedical Engineering.

Also, biological tissue changes according to the force applied from the outside via biomaterials, and we are pursuing the controlling of such changes by interface functions.



Stress distribution of bone around the implant in a finite element analysis model using patient data.

These PET images show the metabolic activity of bone around an implant when force is applied to the implant



(¹⁸F- isotope radioactive tracer)

Example of Interdisciplinary Cooperation

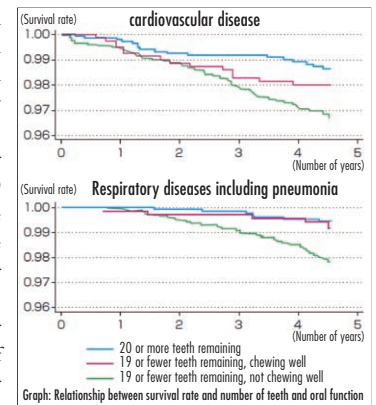
Research has revealed a clear relationship between oral health and death due to pneumonia and stroke.

The Tohoku University Graduate School of Dentistry, in collaboration with Nihon Fukushi University and others, conducted a large-scale cohort study targeting the elderly in the city of Iwanuma, Miyagi Prefecture.

Analyzing 4,425 people followed for four years, the study showed that people with 19 or fewer teeth and who could not masticate well had a lower survival rate by major cause of death compared to people with 20 or more teeth.

The risk of death from cardiovascular disease was 83% higher, and the risk of respiratory disease mortality was 85% higher (*J Dent Res 2011*). The study suggested the

risk of death from these diseases increases with the loss of teeth or not being able to masticate. It is possible to reduce the risk of death by these diseases by maintaining the health of the oral cavity. Other research we conducted showed that when the oral cavity is healthy, there is less of a chance for the individual to need long-term care (*J Am Geriatr Soc 2012*).



A Tohoku University School of Dentistry student interviews a resident of temporary housing in the area struck by the tsunami.

What is Interface Oral Health Science?

(Interface Oral Health Science, since 2002)

– Next-generation oral health science from
Tohoku University Graduate School of Dentistry –

The Birth of Interface Oral Health Science

The academic field that is acknowledged as dentistry (dental medicine) nowadays was mainly treatment theory. Etiology and basic dentistry were subdivided and far from systematized. In 2002, Tohoku University Graduate School of Dentistry proposed connecting the various areas of expertise, which were at that time subdivided, and systematizing them as Interface Oral Health Science.

The oral cavity consists of 1) oral tissue (teeth, mucosa, bone, muscles, etc. – the living body); 2) parasitic microorganisms that live in the oral cavity; and 3) biomaterials, as well as mechanical stress as represented by the occlusal force. These are the characteristics of the oral cavity.

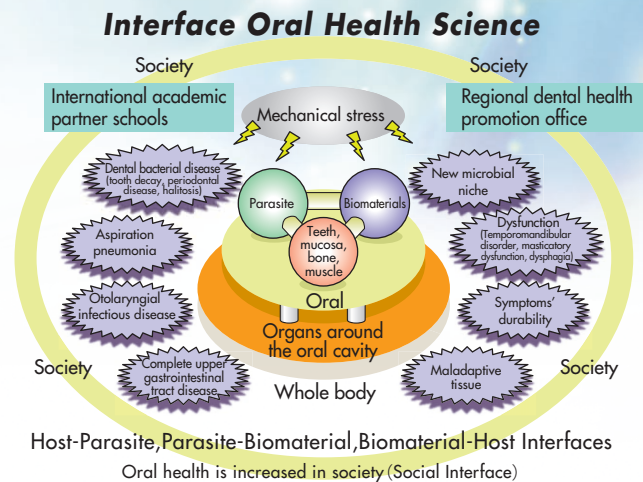
Interface oral health science concerns itself with the places where the various systems interact. In other words, healthy oral function works where the interfaces harmonize biologically and biomechanically. In addition, the oral cavity is itself an interface, between the inner body and the outside world. It is understood that oral cavity related diseases, such as aspiration pneumonia and gastrointestinal tract infections, occur due to the collapse of the interfaces between systems.

From Oral Cavity Interface to Academic Interface – and Society Interface

This concept not only covers the area of oral health science and dental science, it relates to a wide range of academic disciplines, including medicine, agriculture, materials science, pharmacology and so on. Practicing interface oral health science leads to further promotion of dental research and activation of interdisciplinary research in related areas.

In 2007, the “Highly-functional Interface Science: Innovation of Biomaterials with Highly-functional Interface to Host and Parasite” program was approved by Japan’s Ministry of Education, Culture, Sports, Science and Technology, and we began collaborating with Tohoku University’s Institute for Materials Research and Kyushu University’s Research Institute for Applied Mechanics to conduct research and development on new biomaterials and develop clinical applications aimed at interface control. As a successor project, moreover, “Creation of a Biological and Non-Biological Intelligent Interface” was launched in 2012. These are the realization of the “Academic Interface” that aims to link existing academic fields and create a new academic discipline.

In addition, in order to achieve healthy oral function in local and international communities, it is essential to communicate with local and international communities interactively (two-way communication). In other words, it is necessary to gain an understanding of the status of the oral health of local residents, solve existing problems, and return these solutions to local communities. We also must investigate the oral health status overseas and provide what is needed, as well as cooperate with overseas research institutes and contribute to the general good by returning the outcomes of Japanese dental research to the international



community. The Tohoku University Graduate School of Dentistry has set up a Regional Dental Health Promotion Office to enhance cooperation with local communities; and to strengthen cooperation with foreign research institutes, it has concluded international academic partnerships with core schools in the United States (Harvard University), Canada (the University of British Columbia), the United Kingdom (King’s College London), Sweden (Umeå University), Finland (Oulu University), Asia (Peking University, Sichuan University, Tianjin Medical University, Dalian Stomatological Hospital, and Fujian Medical University in China; Seoul University and the University of Chonnam in South Korea) and Oceania (University of Sydney, Australia). They are playing an important role as “Regional and International Interfaces.”

Sending out ‘Interface Oral Health Science’ to the World

At present, the concept of Interface Oral Health Science is widely recognized in Japan and abroad as the next generation of dentistry and oral science. In 2005, the International Symposium for Interface Oral Health Science: IS-IOHS was held in Sendai and many researchers gathered there from Japan and overseas. Its results were compiled and published as an English book and distributed around the world. Every 2 years since 2005, IS-IOHS has been held in Sendai, with publication of an English book about the new outcomes of IOHS. In addition to Sendai, the Third (2009) and Fourth (2011) Tohoku-Harvard-Forsyth Symposia (Satellite symposia) were held in Boston in collaboration with the Harvard-Forsyth Research Institute. Interface Oral Health Science is spreading more and more. Its foundation is in the characteristics of Tohoku University Graduate School of Dentistry – the uniqueness of dentistry and oral science and the desire to conduct unique research with universality to other academic disciplines; the passion of research educators and graduate students who gather at the place; and finally, the orientation toward international, interdisciplinary and fusion-oriented research.

Message from students about dental research at Tohoku University



Master course 2nd year
Hiroyuki Hatakeyama
(Miyagi Prefecture)

You can study and remain employed at the same time.

I specialize in the geriatric welfare sector, and work as a consultant at an intensive-care home for the elderly. Right now, I'm involved with nursing care and welfare education. In my work, I noticed that elderly people who have lost their teeth tend to have a high level of nursing care requirements, and that, conversely, elderly people who maintain their own teeth tend to show a low level of nursing care requirements. It occurred to me that, giving caregivers a better understanding of the importance of oral care would promote preventive long-term care service. To study what would be needed to incorporate effective oral care education into nursing care educational programs, I joined the Tohoku University Graduate School of Dentistry.

Since I'm from a non-dentistry field and have limited knowledge of dental treatment, I needed to gather all my courage to apply to this school. However, the Department offers courses that allow working students to study via the Internet, and the professors provide extensive support, responding to our questions and doubts at great length using email and other tools. So now, I am able to study and carry out research without any anxieties whatsoever. I am especially grateful to all the members of the faculty who are patiently teaching me—a total novice in this field—dental treatment from the basics. The graduate school has made me aware of the fun of learning and conducting research.



Doctor course 3rd year
Keiko Viviane Kawata
(Brazil)

Basic research connected to clinical practice is a lively program.

I first enrolled in the Faculty of Dentistry, University of Sao Paulo, in the state of Sao Paulo, Brazil. Since first year, I have been interested in research and often visited the Faculty of Pharmaceutical Sciences Laboratory of Physics & Science, biochemistry.

After graduating from university, I visited Japan with support of the JICA as I have roots as a Japanese-Brazilian, and enrolled in the Tohoku University Department of Medical Science Master course (Institute of Development, Aging and Cancer, Department of Immunogenetic Control). I had opportunities to learn a variety of scientific methodologies and ways to study through meeting with researchers in a variety of fields.

For the Doctoral course, I considered the Graduate School of Medicine, but eventually decided on the School of Dentistry. The reason is that basic research work is active in addition to clinical research at this graduate school and I thought I could research the themes I really wanted to work on. One research theme is *Porphyromonas gingivalis*, and the bacteria component's toll-like receptor system (TLR), which is one of the research themes regarding endodontic treatment of periodontal disease. By linking this research and the study of immunological component in periodontal tissue inflammation, I can do that research that I truly want to do.



Doctor course 4th year
Hakami Zaki Weli
(Kingdom of Saudi Arabia)

I am very proud of having this opportunity to study in Tohoku University Graduate School of Dentistry.

I am very proud of having this opportunity to study in Tohoku University: the educational environment is very rewarding and creative for students, especially under the supervision of experienced faculty members and with the support of other students. Carrying out my clinical and academic duties satisfactorily in the University, I am sure that I will be able to be a confident Orthodontist.

Tohoku University has introduced numerous scientific researches to the field of Dentistry, particularly in my field of Orthodontics. Moreover, it has discovered many materials and techniques that enable orthodontic treatment with high quality and in reasonable treatment duration.

Tohoku University has strong educational curriculum with strategy for personal education. Students are provided with front-line scientific information based on problem-oriented approach. For example, in weekly-held journal club sessions, we are kept update with newly published international articles with high impact factors. There is also laboratory and paper work that develop our clinical skills.

Training in the Tohoku University Hospital Dental Clinics is highly advanced: the clinics are supplied with high standard machines and instruments and are supervised by experienced staff members. Students treat many patients with different malocclusion and make all appliances by themselves, which allow them to be familiar with various technical treatments. In weekly-held clinical cases presentation meetings, students present their own cases and have discussions with faculty members regarding their treatment diagnosis and results based on problem-oriented approach and evidence-based dentistry.



Doctor course 4th year
Tamaki Ogawa
(Hyogo prefecture)

I'm gaining clinical experience in addition to research – and my life is fulfilled.

I enrolled in the Doctor course after I completed one year of clinical training at Tohoku University Hospital upon graduation from School of Dentistry, Tohoku University.

What made me think of continuing my research after the training was my experience in basic laboratory work. I experienced the satisfaction of research during the training in the lab and really enjoyed the experience when I was a 5th year undergraduate.

I was hesitating to enroll in the Graduate School of Dentistry, as I wanted to learn clinical dentistry while I was an undergraduate; however, I learned that at the Graduate School of Dentistry you can gain clinical experience at the same time as doing research. Therefore, I decided to continue at the university.

I'm working on basic research themes which are also related to clinical dentistry in graduate school.

Currently, I'm preparing a presentation for an upcoming international symposium with great support from the teachers. This is my first time to attend an international symposium, and I'm looking forward to meeting and communicating with various teachers besides the presentation. I expect to learn many things from this experience.

In clinical practice, there are many opportunities to learn dental medicine from various facilities such as university hospitals, dental practitioners and dental hospitals, as well as teachers. I'm very busy with research and clinical practice, but I feel that my life is fulfilled.

In the future, besides research and clinical practice, I want to take on various other challenges. I think graduate school is a place where you can reach your potential and gain valuable experience.

I'm sure students have various reasons for studying at graduate schools at Tohoku University. I feel graduate school here is a place where you can gain valuable experiences and expand your abilities.

The Master's Course

Students must enroll for more than two years and earn 30 credits or more, or earn the equivalent credits within one year.

Chronology of events that led to the establishment of the Master's course

Dental medicine has been progressing rapidly in recent years, and dental treatment support staff, such as dental hygienists, technicians and other professionals, is now being expected to acquire an even wider range of advanced knowledge and to possess specialized skills based on such knowledge. To promote the research and development of dental equipment and materials that support advanced dental medicine, moreover, it is becoming an urgent task to train researchers and developers who are familiar with the latest advances in dentistry and oral science.

On the other hand, the importance of oral functions such as eating and speaking is becoming more broadly recognized. People in occupations who have no opportunities to receive specialized dentistry education, such as nurses, speech therapists, nursing teachers, and health administration

officials are increasingly being called on to demonstrate knowledge and skills relating to dental and oral care in executing their nursing, long-term care, health guidance, public relations, and other awareness-raising activities. Examples include the provision of oral health guidance and management, and education on maintenance of the oral cavity.

In April 2004, the Tohoku University Graduate School of Dentistry established a new Master's program especially for these types of individuals, and opened the door for specialized education and research in dentistry and oral science with the aim of cultivating the abilities needed for such advanced specialist professions, or the ability to conduct research on dentistry and oral science.

Admissions policy

The missions of Tohoku University Graduate School of Dentistry are to contribute to the progress and development of dentistry by promoting creative and innovative research, and to enhance the health and welfare of all mankind.

The goal of education and research at our graduate school is to cultivate a scientific mind that constantly questions and investigates all phenomena. To this end, we strive to produce researchers, medical professionals, educators and administrative officers equipped with high-level specialized

knowledge and skills, as well as exceptional insights, who will play an active role not only in the regional community and within Japan, but also in the broader global community.

The Master's course seeks individuals who have diverse and specialized academic knowledge and skills related to oral health, hygiene and public health, health science, speech and language therapy, medical sociology, agriculture, engineering, and science, and who are willing to carry out active research into dentistry and oral science.

Curriculum policy

The Master's course curriculum, which is designed to provide flexible programs that meet students' interests, consists of a wide range of basic and specialized subjects, beginning with Introduction to Dentistry, and covering subjects needed for future dentistry and oral science such as Medical and Dental Biomaterials, Theory of Medical/Dental Equipment, Food Science, International Dental Health, and Social Dentistry. Each student studies under the guidance of more than one instructor. During the first year, students take Introduction to Dentistry as well as Introduction to Clinical Dentistry and Practical Training at Hospitals to acquaint themselves with dentistry and dental medicine. In the Special Training for the Master's Thesis, which covers the period from the first to

second years to the completion of a Master's thesis, students study the Basic Theory of Graduate School Research to familiarize themselves with matters that govern all research, from ethics to technical regulations. They then summarize their research themes and plans as a Summary of Theme Selection, allowing them to begin research at an early stage of the Master's course. These courses allow dental hygienists and technicians, nurses and other healthcare professionals, as well as graduates in science and engineering, and nutrition and health, to acquire extensive knowledge and advanced research skills in dentistry and oral science that will enable them to contribute to maintaining and promoting these areas in public health.

Diploma policy

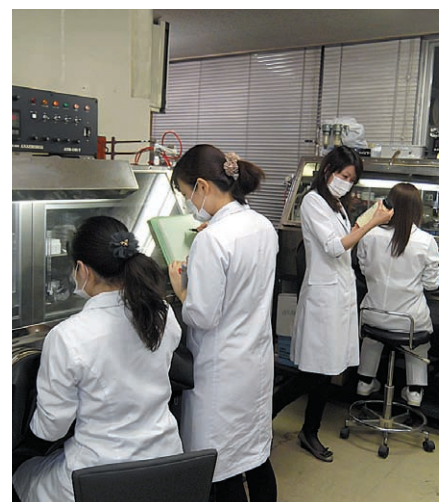
To complete the Master's course in dentistry, students must be enrolled for two years or more, and earn 30 credits or more (18 credits or more from compulsory subjects and 12 credits or more from elective subjects). They must also undergo the necessary research guidance and submit a Master's thesis, then pass the evaluation and final examinations to be certified as having completed the course.

If a student is recognized to have made outstanding research achievements, only one year of study is required.

Students who are currently employed or subject to other special circumstances are permitted to study for more than two years under the planned schedule, during a period to be determined by the School.

Course List for Master's Course (2013)

Classification	Courses	Credits	Classification	Courses	Credits
Compulsory subjects	Introduction to Dentistry	2	Electives	Social Dentistry	2
	Introduction to Clinical Dentistry	1		Comprehensive Dentistry	2
	Practical Training at Hospital	1		Pediatric Oral Development	2
	Research and Technical Training	3		Oral Rehabilitation and Recovery	2
	Specialized Dentistry	4		Stomatognathic Function	2
	Special Training for Master's Thesis	7		Dentistry with Disabilities	2
				Geriatric Dentistry	2
Electives	Dental Biology	2		Preventive Dentistry	2
	Dental Diseases	2		Oral and Maxillofacial Reconstruction	2
	Medical/Dental Biomaterials	2		Controlling Oral Immune Pathology	2
	Medical/Dental Equipment	2		Oral Health and Longevity	2
	Food Science	2		Oral Health Science Theory	2
	International Oral Health	2		Special Training for Oral Cancer Care	1



The Doctoral Course

Students must enroll for more than four years, earn 30 credits or more, or earn the equivalent credits within three years.

Admissions policy

The missions of Tohoku University Graduate School of Dentistry are to contribute to the progress and development of dentistry by promoting creative and innovative research, and to enhance the health and welfare of all mankind.

The goal of education and research at our graduate school is to cultivate a scientific mind that constantly questions and investigates all phenomena. To this end, we strive to produce researchers, medical professionals, educators and administrative officers equipped with high-level specialized

knowledge and skills, as well as exceptional insight, who will play an active role not only in their regional community and within Japan, but also in the broader global community.

We are seeking individuals for the doctoral course who, in addition to having a strong motivation to study dentistry combined with outstanding capabilities for doing so, have a broad perspective and flexible sensibilities, and who can carry out creative, innovative, academic and groundbreaking research, following the principle of integrating basic and clinical research.

Curriculum policy

The doctoral course's dentistry curriculum, in which one student studies under the guidance of more than one instructor, encourages students to begin research at an early stage of their doctoral course, acquire expertise and specialized knowledge, and develop an interdisciplinary outlook. The Special Training for a Doctoral Thesis, provided from the first to the fourth year, helps students develop the skills necessary to write a doctoral thesis. The Basic Theory on Graduate School Research class, taken in the first year, provides students with the mass of rules that a researcher must comply with, from research ethics to various types of regulations. At the Research Theme Decision Conference, first-year students present their research proposals, and hold discussions with a variety of supervisors developing their research skills in the early stages of their doctoral education. Students are required to take the Advanced Theory of Dentistry course from the first year, in which they learn about

the latest research from instructors who are experts in various fields. They acquire many different experimental techniques necessary for conducting research in the Experimental Technique Training course. In addition, Dental Seminars, in which small groups of students work with the latest research information, are designed to help develop their sense of purpose and increase their motivation to conduct research. To produce quality theses, assessments from many different viewpoints by multiple instructors are essential. To make this possible, we have been strengthening the screening setup by introducing a system of a preliminary reviewing that uses "contributing a paper to a top-rated international journal" as the chief criterion. At the same time, we provide assistance to students in giving presentations at international academic meetings, with the aim of having them cultivate a global outlook and perspective.

Diploma policy

To complete the Doctoral course, students are required to be in the program for four years or more, and earn 30 credits or more from the following subjects: nine or more credits for the Advanced Theory of Dentistry course, six or more credits for Dental Seminars, six or more credits for the Experimental Technique Training course, and nine or more credits for Special Training for Doctoral Thesis. Students must also receive the necessary research guidance and submit a Doctoral thesis, then pass the

evaluation and the final examination.

If a student is recognized to have made outstanding research achievements, only three years of study are required. Students who are currently employed or are subject to other special circumstances are permitted to study for more than four years under the planned schedule, during a period to be determined by the School.

Course List for Doctoral Course, Dentistry Curriculum (2013)

	Dentistry theory (3 credits each)	Dentistry practice (2 credits each)	Experimental technique training course (2 credits each)	Doctoral Thesis Special Training (9 credits each)
Oral biology	- Oral Ecology and Biochemistry - Dental Pharmacology - Oral Microbiology - Periodontology and Endodontology - Oral Molecular Bioregulation	- Oral Ecology and Biochemistry - Dental Pharmacology - Oral Microbiology - Periodontology and Endodontology - Oral Molecular Bioregulation	- Oral Ecology and Biochemistry - Dental Pharmacology - Oral Microbiology - Periodontology and Endodontology - Oral Molecular Bioregulation	- Oral biology
Oral Function and Morphology	- Oral and Craniofacial Anatomy - Oral Physiology - Advanced Prosthetic Dentistry - Aging and Geriatric Dentistry - Comprehensive Dentistry	- Oral and Craniofacial Anatomy - Oral Physiology - Advanced Prosthetic Dentistry - Aging and Geriatric Dentistry - Comprehensive Dentistry	- Oral and Craniofacial Anatomy - Oral Physiology - Advanced Prosthetic Dentistry - Aging and Geriatric Dentistry - Comprehensive Dentistry	- Oral Function and Morphology
Restorative Dentistry	- Dental Biomaterials - Operative Dentistry - Fixed Prosthodontics	- Dental Biomaterials - Operative Dentistry - Fixed Prosthodontics	- Dental Biomaterials - Operative Dentistry - Fixed Prosthodontics	- Restorative Dentistry
Oral Health and Development Science	- Preventive Dentistry - Pediatric Dentistry - Orthodontics and Dentofacial Orthopedics - Oral Dysfunction Science - Community and International Health	- Preventive Dentistry - Pediatric Dentistry - Orthodontics and Dentofacial Orthopedics - Oral Dysfunction Science - Community and International Health	- Preventive Dentistry - Pediatric Dentistry - Orthodontics and Dentofacial Orthopedics - Oral Dysfunction Science - Community and International Health	- Oral Health and Development Science
Oral Medicine and Surgery	- Oral Pathology - Oral Diagnosis - Oral and Maxillofacial Surgery - Dento-oral Anesthesiology	- Oral Pathology - Oral Diagnosis - Oral and Maxillofacial Surgery - Dento-oral Anesthesiology	- Oral Pathology - Oral Diagnosis - Oral and Maxillofacial Surgery - Dento-oral Anesthesiology	- Oral Medicine and Surgery
Craniofacial Engineering and Regeneration	- Craniofacial Development and Regeneration - Craniofacial Function Engineering (CFE)	- Craniofacial Development and Regeneration - Craniofacial Function Engineering (CFE)	- Craniofacial Development and Regeneration - Craniofacial Function Engineering (CFE)	- Craniofacial Engineering and Regeneration
Molecular Pathogenesis of Oral Tumor	- Oral Cancer Therapeutics - Molecular Oral Oncology	- Molecular Pathogenesis of Oral Tumor	- Oral Cancer Therapeutics - Molecular Oral Oncology	- Molecular Pathogenesis of Oral Tumor
Engineering Dental Tooth Regeneration	- Engineering Dental Tooth Regeneration	- Engineering Dental Tooth Regeneration	- Engineering Dental Tooth Regeneration	- Engineering Dental Tooth Regeneration
Intractable Diseases and Immunology	- Intractable Diseases and Immunology	- Intractable Diseases and Immunology	- Intractable Diseases and Immunology	- Intractable Diseases and Immunology
Immune Regulation and Oral Immunity	- Immune Regulation and Oral Immunity	- Immune Regulation and Oral Immunity	- Immune Regulation and Oral Immunity	- Immune Regulation and Oral Immunity
Geriatric Oral Science	- Geriatric Oral Science	- Geriatric Oral Science	- Geriatric Oral Science	- Geriatric Oral Science
Oncology dentist course	- Clinical Oncology I - Clinical Oncology II - Clinical Oncology III			
	- Advanced Theory of Oral Health Science (specialized classes) (2 credits)		- Special training in Oral Cancer Screening (1 credit)	

Oral Biology

Oral Ecology and Biochemistry

Professor Nobuhiro Takahashi

Continually moistened with saliva, the oral cavity is made of various soft and hard tissues, such as teeth, gingiva and the tongue, and is the pathway of foods to enter the body. In addition, a tremendous number of microorganisms inhabit there in the form of oral biofilm (or dental plaque). The oral cavity forms an ecosystem where the host (humans) and parasites (microorganisms) cohabit. Disruption of balance of this healthy oral ecosystem leads dental caries, oral malodor and periodontal diseases. Using leading-edge techniques of molecular biology, anaerobic experimental systems and the notion of "omics", we conduct research on the role of oral biofilms in oral health and disease from an oral ecosystem viewpoint. In addition, we propel clinical research on caries-preventive effects of xylitol, fluoride etc, and on parasite-caused degradation of biomaterials. Recently, we have also started conducting research on the metabolism of cancer cells which exhibit a similarity to parasites.

Main research themes

- Genomics, proteomics, and metabolomics of oral biofilm
- Pathogenicity of dental caries-, oral malodor- and periodontal disease-associated microorganisms using anaerobic experimental systems
- Caries-preventive properties of xylitol and fluoride
- Evaluation of cariogenicity of food products using pH-telemetry
- Interactions between oral biomaterials and parasites
- Metabolomics (sugar and amino acid metabolite analyses) of cancer tissue



Anaerobic chamber, simulating anarobic conditions in oral biofilm.

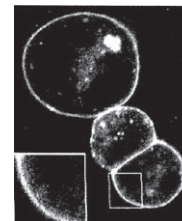
Dental Pharmacology

Professor Minoru Wakamori

In dental pharmacology, the major goal of our research programs is to elucidate the operating principles of the body to keep homeostasis on the molecular level by utilizing electrophysiological and molecular biology techniques. Specifically, we are interested in mechanisms to regulate intracellular Ca^{2+} concentration, and transduction mechanisms of oral sensations. By understanding the actuating mechanisms of various sensors in oral cavity, we can contribute to the discovery of the even safer dental treatment methods and to improvement of quality of life in our aging society. In addition, understanding functional mechanisms of biological sensors will eventually be of great benefit to mechanical engineering and electronic engineering fields.

Main research themes

- Functional Analysis of Ca^{2+} -permeable Cation Channels
- Molecular and Neurobiological Studies of Taste, Pain and Touch Sensations



Cellular localization of TRPC5-eGFP fusion protein expressed in a single HEK293 cell.

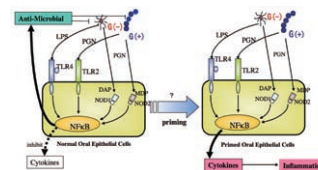
Oral Microbiology

Professor Haruhiko Takada

In the past two decades, immunologists have been excited about the innate immune system, which paternally recognizes various common microbial structures. Cell-surface Toll-like receptors (TLRs) recognize bacterial cell-surface components, while intracellular NOD1/2 recognize bacterial cell-wall peptidoglycan: NOD1 and NOD2 recognize desmuramylpeptide and muramyl dipeptide (MDP), respectively. With the aim of elucidating the pathogenesis of infectious diseases in oral mucosa, represented by periodontal diseases, we have investigated innate immune responses via TLRs and NOD1/2 in various cell cultures prepared from human periodontal tissues.

Main research themes

- Innate immunity in periodontal tissues and periodontal diseases
- Bacterial cell-wall peptidoglycans in relation to innate immunity
- Immunobiological activities of bacterial cellular components, especially those from oral bacteria
- Mechanisms of apoptosis induced by anti-tumor drugs in cancer cells



Normal oral epithelial cells express various TLRs and NOD1/2, and produce anti-microbial peptides not accompanied by the production of inflammatory cytokines in response to comparable ligands. On the other hand, primed cells produced inflammatory cytokines.

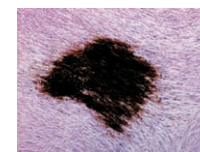
Periodontology and Endodontology

Professor Hidetoshi Shimauchi

One of our projects is studying on the onset mechanism of periodontal disease (marginal and apical periodontitis), representative chronic inflammation in the oral cavity, in terms of the interaction between host cells and bacteria, and also we study on the regenerative mechanism of periodontal tissue. In addition, I perform the study for apply ME such as lasers for periodontics and endodontics.

Main research themes

- Analysis of the onset mechanism of marginal and apical periodontitis
- Analysis of the interaction between cells in the periodontium
- Analysis of the periodontal regenerative mechanism and application to the treatment
- Development of method for periodontal diagnosis using ME
- Development of periodontal regenerative therapy using new biomaterials



The calcified nodule formed of Periodontal Ligament Cells.

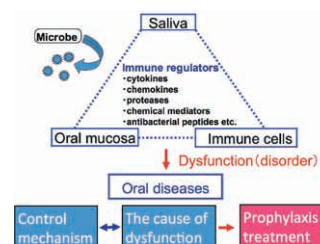
Oral Molecular Bioregulation

Professor Shunji Sugawara

Interaction among oral mucosal cells, saliva and immune cells through immune regulatory factors and cell-to-cell contact is critical for mucosal defense, and dysfunction (disorder) of the interaction leads to onset of oral mucosal and salivary gland diseases. We investigate the underlying molecular mechanism to overcome these diseases.

Main research themes

- Host Defense and Diseases in the Oral Mucosa
- Inflammatory Mediators and Cytokines in Pathological Conditions
- Immune Regulation of Saliva and Diseases in the Salivary Glands
- Mechanism of Metal Allergy Development
- Regulation of Inflammation by Biotin



Oral mucosal defense and research aim

Oral Function and Morphology

Oral and Craniofacial Anatomy

Professor Hiroyuki Ichikawa

Our division has research themes about the human anatomy, particularly focused on oral structures. The morphology of human and other mammals is also compared. In addition, we are interested in motor, sensory and autonomic systems of oro-facial regions. For this purpose, the distribution and function of neurotransmitters, neuromodulators and other substances is investigated in the central and peripheral nervous systems. Morphometric methods are used for these anatomical and microscopic studies.

Main research themes

- Comparative anatomy of the tooth in various mammalian species
- Comparative morphometry of craniofacial regions
- Congenital deficiency of the human tooth
- Morphometric research of the tooth in old Japanese
- Anatomy of oro-facial regions
- Sensory innervation of oro-facial regions

Oral Physiology

Professor Minoru Wakamori

Oral physiology mainly concentrates on the research on biological processes in the oral and maxillofacial regions. We are in the field of fundamental studies that establishes basic theories from our understanding of physiological functions, such as mastication, oral sensation including gustatory sensation, function of saliva and vocalization. Presently, many still unanswered questions exist in regards to the oral and maxillofacial region's connection to overall bodily functions, including higher brain functions. In the department of oral physiology we focus on individual organism and cell level research that investigate these questions by using electrophysiological and molecular biological techniques.

Main research themes

- Neurophysiological analysis of information-processing mechanisms in cortical somatosensory system
- Analysis of receptor mechanisms through mechanical stress in the periodontal tissues and its control by gene transfer
- Analysis of differentiation and regeneration inducing signal reception and its transmission mechanism in neurons and osteoblasts

A spinal dorsal horn neuron and serotonergic axon terminals.



Distribution of synapses between a spinal dorsal horn neuron and serotonergic axon terminals.

Advanced Prosthetic Dentistry

Professor Keiichi Sasaki

Focus of research and education of our division is on reconstruction of morphology and function of the patients with partial edentulism or maxillofacial defects. In addition to developing the conventional prosthodontic modalities such as removable and fixed dentures, we aim to create novel prosthodontics utilizing the dental implant, tooth transplantation, and tissue regeneration, and to clarify the biomechanical and mechanobiological interaction at the interface between prosthesis consisting with biomaterials and living tissues, which is essential for the success of prosthodontics.

Main research themes

- Biomechanics based upon in vivo measurements of mechanical features relating to removable partial denture prosthetics and implant prosthodontics
- Molecular imaging study with nuclear medicine on bone remodeling related to removable partial denture prosthodontics and implant prosthodontics
- Study on transplantation and regeneration for edentulous prosthodontics and maxillofacial prosthetics
- Development and translational researches of novel biomaterials and functional interface between biomaterials and living tissues
- Study on Long-term clinical results of removable partial dentures and implant prosthodontics

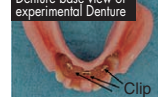
4 Implant-supported



2 Implant-supported



Denture base view of experimental Denture



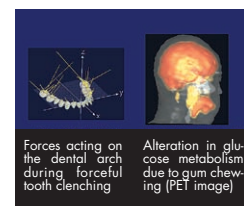
Aging and Geriatric Dentistry

Professor Masahiko Kikuchi

Through biomechanical, morphometrical, physiological, and biochemical studies on stomatognathic functions and their regulations, we work on finding effective intervention measures for the elderly with serious impairment of oral functions. We also pursue the interrelation between oral and systemic health, and work on establishing oral health promotion measure which leads independent lives of the elderly.

Main research themes

- Studies on forces force generation strategies of the stomatognathic system
- Electrophysiological, nuclear-medical, or kinematical studies on oral functional motion including mastication and deglutition
- Behavioral and biochemical studies on the interaction between stress and stomatognathic functions and dysfunctions
- Large-scale cohort studies on the causal relationship of oral and systemic health
- Studies on the rehabilitation of oral functions



Forces acting on the dental arch during forceful tooth clenching

Alteration in glucose metabolism due to gum chewing (PET image)

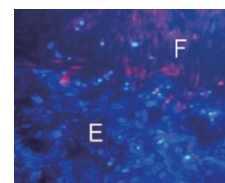
Comprehensive Dental Care Unit

Professor Masahiko Kikuchi

The department of comprehensive dentistry aims to develop superior primary care in general dentistry and also practices the management of clinical training program for post graduate residents. Furthermore, following basic and clinical research projects are conducted with the graduate students of this department.

Main research themes

- Periodontal regeneration using periodontal ligament cells
- Oral hygiene and oral microorganisms in the elderly
- Relationship between dental diseases and systemic illness
- Development of effective treatment methods in primary care
- Circadian rhythm of dental pain



The role of epithelial rests of Malassez to promote periodontal regeneration.

Restorative Dentistry

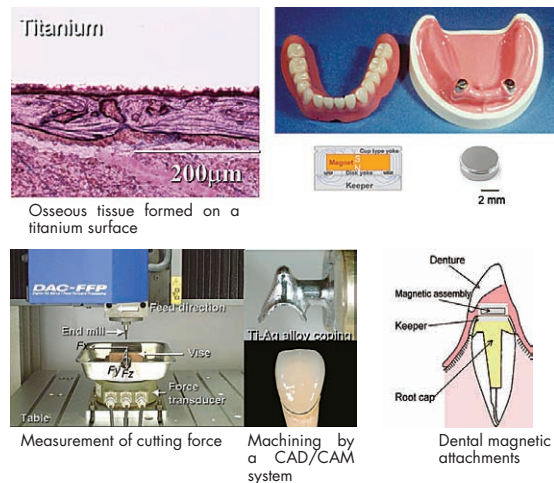
Dental Biomaterials

Professor **Osamu Suzuki** (collateral office)

Dental and medical restorative materials are studied under developments of dental alloys, magnetic materials and devices, new implant materials, and machining and forming methods. Furthermore, degradation and safety of the dental restoration materials are inquired.

Main research themes

- New titanium alloys for dental appliances
- New free-cutting dental materials suitable for dental CAD/CAM systems
- Magnetic materials and devices for dental applications
- Influence of a static magnetic field on hard and soft tissues
- Analysis of ions released from dental materials
- Degradation and safety of dental materials in an oral cavity
- Mild antimicrobial or bacteriostatic titanium alloys
- Next-generation dental apparatus



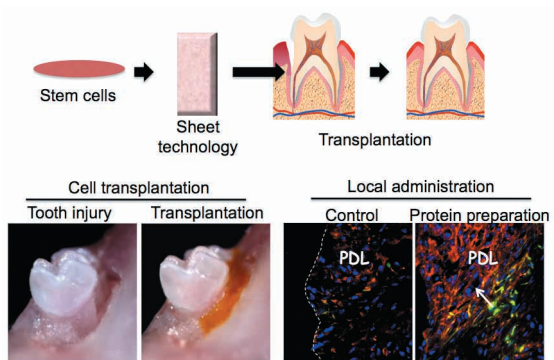
Operative Dentistry

Professor **Masahiro Saito**

We work mainly on research of the following topics from a clinical perspective: physical properties of composite resins used in restoration for diseases of the hard tissues such as the dental carries; measurement of adhesive strength onto enamel and dentin; observation of adhesion/joining conditions by electron microscope; long-term clinical performance of oral restorative materials using the replica method; conformity precision with respect to castability of titanium restorative materials and dentin; and strengthening of the physical properties of porcelain inlays. We also work on clinical studies that are re-restoration treatment with materials not containing allergic materials, and application of novel disinfecting technique using functional water. In addition to these studies, we develop regenerative therapy which expected to create innovative dental therapeutic systems in the 21st century. A feasibility study of the realization of tooth regeneration therapy is performed in research projects that are stem cell transplantation and local administration of bioactive molecules.

Main research themes

- Development of Tooth Regeneration Therapy
- Investigation of Molecular Mechanisms that regulate Periodontal ligament formation
- Research Related to Physical Properties and Adhesion/Joining Conditions onto Dentin of Composite Resin
- Research Related to Dental Precision Casting and Level of Conformity of Pure Titanium and Titanium Alloys
- Research Related to the Strengthening of Physical Properties and Clinical Application of Ceramic Inlays
- Research Related to Dental Metal Allergies



Development of tooth regeneration therapy
 A model for tooth regeneration therapy (Upper panel)
 Cell transplantation by using sheet technology (Lower left panel)
 Local administration of bioactive molecules (Lower right panel).
 Arrow indicated regeneration of fibers in tooth.

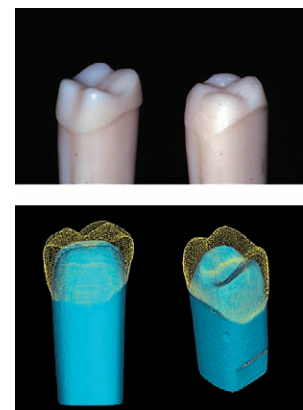
Fixed Prosthodontics

Professor **Keiichi Sasaki**

Basic and clinical study on accuracy, strength and esthetics of fixed prosthetics made from various kinds of biomaterials (metal, dental porcelain and plastics material).

Main research themes

- Study on the quantitative assessment of the teeth prepared by dental students.
- Study on indirect technique
- Study on organic dental materials and inorganic dental materials (impression materials, indirect resin composite, dental porcelain, dental cement and composite materials)
- Study on fabricating procedures applying CAD/CAM system
- Study on preparation of TiO₂ coating on dental metal materials
- Study on esthetic dentistry
- Study on clinical course of prosthetic restorations and implants.
- Development and research of dental remedy applying an effective disinfection system via hydroxyl radical formation by photo energy



Tooth preparation for complete cast restoration is a routine clinical procedure performed intra-orally prior to taking impression. Subjective evaluation of the abutment teeth prepared by dental students was conventionally carried out (fig. 1). Applying non-contact laser beam three-dimensional shape measuring system in 90sec, it was then possible to visualize computer-graphically the entire shape of the prepared tooth from any direction (fig. 2). Objective evaluation of abutment teeth was effective for tooth preparation practice.

Oral Health and Development Science

Preventive Dentistry

Professor Takeyoshi Koseki

The Division of Preventive Dentistry aims to prevent all oral disorders and to promote and maintain oral health and its full function. In the trend of rediscovering the importance of preventive dentistry, our researches focus on the effective measures of preventing oral diseases and the strategies of health promotion involving the individual QOL throughout their entire lifetime.

Main research themes

- Estimation of progression and future risk of dental caries
 - 1) Accurate evaluation of early lesion of dental caries by using ultrasonic devices
 - 2) Risk assessment of enamel surfaces by using laser technology
- Risk assessment of periodontal diseases
 - 1) Analysis of microbiological risk factors of dental plaque
 - 2) Development of effective protocol of periodontal supportive therapy
- Oral malodor research
 - 1) Microbiological study of source of malodor
 - 2) Development of portable measuring system of oral malodor
 - 3) Psychological approach of treatment of oral malodor
- Application of fluoride for caries prevention
 - 1) Promotion of fluoride application in public measure of caries prevention
- Field research of community oral health
 - 1) Development of educational dental health checkup with health promotion
 - 2) Monitoring the prevalence and incidence rate of oral diseases



Portable measuring system of oral malodor

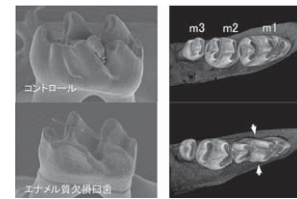
Pediatric Dentistry

Professor Satoshi Fukumoto

Our division promotes clinical, basic and epidemiological research for tooth development, tooth trauma, mucosal disease to create healthy oral environment in children.

Main research themes

- Identification of novel gene involved in tooth development
- Study of enamel formation
- Analysis of gene associated with oral disease
- Regeneration of tooth and salivary gland using tissue engineering
- Development of stem cell research associated with syndromes
- Evaluation of new materials for prevention of dental caries



Enamel dysplasia using gene targeting (left). Control of tooth width using gene manipulation.

Orthodontics and Dentofacial Orthopedics

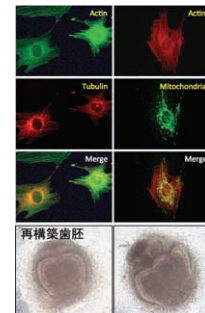
Professor Teruko Takano-Yamamoto

One of the clinical dental department that focus on a research related to the diagnosis and treatment of abnormal morphological and functional occlusion. Our aim is to develop a new diagnosis and treatment methods and to elucidate craniofacial growth mechanics, by various clinical and basic scientific research.

We also offer a 3-year postgraduate orthodontic clinical training program with addition to the PhD course. Our department is accredited by the Japanese Orthodontic Society as a training institute for orthodontic specialists.

Main research themes

1. Clinical research
 - The use of miniscrew as an orthodontic anchorage
 - The use of functional evaluation (gnathohexagraph) in orthodontic treatment
 - Relationship between Sleep Apnea Syndrome and orthodontics
 - The use of various occlusal indices in quantitatively evaluating the quality and severity of the pre- and post malocclusion in orthodontic treatment
2. Basic research
 - Experimental tooth movement and bone remodeling
 - Biological mechanism of tooth movement
 - Biological mechanism of mechanical response in chondrocytes and osteocytes
 - Biological mechanism of craniofacial development
 - Biohistological study of development, growth and aging of TMJ
 - Histomorphometric study of bone-implant interface
 - The role of pain during experimental tooth movement



fluorescent images of subcellular organelle

Oral Dysfunction Science

Professor Kaoru Igarashi

Oral Dysfunction Science is a clinical dentistry field specializing in research on the normal morphology, function, and development of the stomatognathic system, problems caused by abnormalities, and their treatment.

Main research themes

- Research on efficient tooth movement
- Research on the role of immune cells in destruction of periodontal tissues
- Research on the diagnosis and treatment of maxillofacial congenital anomalies, such as cleft lip and palate (CLP)
- Development of new anti-inflammatory bisphosphonate drugs that also promote bone formation

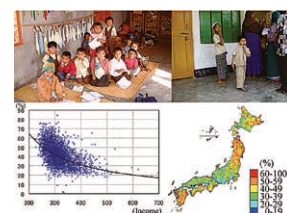
Community and International Health

Professor Ken Osaka

We have carried out research on the influence that the social capital, or bonds to humans and society have on dental health. We have shown socioeconomic status has an impact on the number of remaining teeth in a cohort study. We have also established the number of remaining teeth has associated with the tendency of becoming nursing care-dependent and pneumonia deaths. We are working on education of young students in international support for developing countries, as well as analyzing the oral health condition and health inequalities in Japan and deepening our understanding of the dental care system, long term care insurance system for the elderly and dental public health.

Main research themes

- Association of dental status and society
- The Dental Care System and Health Gap
- Construction of a Project for Effective Prevention of the Need for Nursing Care
- Infectious Disease Countermeasures and Risk Management for Nursing Care Facilities



Oral Medicine and Surgery

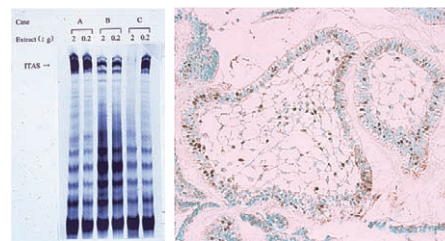
Oral Pathology

Professor Hiroyuki Kumamoto

To clarify the etiology, pathogenesis, pathophysiology, and outcome of various lesions occurring in the oral and maxillofacial region, basic macroscopic and microscopic observations as well as further analyses are performed. Our division research fields are as follows.

Main research themes

- Molecular pathology of lesions of the jaws
- Clinicopathological and genetic studies of developmental abnormalities of the teeth
- Clinicopathological and immunohistochemical studies of the oral immune diseases and cancer
- Investigation on regeneration of the oral and maxillofacial tissues and application of biomaterials



Expression of telomerase in ameloblastoma (a: TRAP assay, b: immunohistochemistry)

Oral Diagnosis

Professor Takashi Sasano

Oral diagnosis should be defined as a systematic process of identifying oral diseases. To obtain an accurate diagnosis that decides proper and rationale treatment planning, our research is focusing on the relation between oral and systemic diseases, and diagnostic imaging of maxillofacial lesions. We are also interested in clinical research of taste disorder, dry mouth and pain based on physiological evidence, and we treat these diseases.

Main research themes

- (1) Clinical study on the relation between oral symptoms and systemic diseases
- (2) Diagnostic imaging of maxillofacial lesions
- (3) Clinical research of taste disorder, dry mouth and pain based on physiological evidence
- (4) Interactions between pain and blood flow

Oral and Maxillofacial Surgery

Professor Tetsu Takahashi

In our division, we cover the diseases of congenital deformities, jaw deformities, benign and malignant tumors, and trauma in oral and maxillofacial area. Our research topics focus on the control and reconstruction of those diseases.

Main research themes

- Research on morphological and functional reconstruction in the oral and maxillofacial area.
- Research on bone augmentation using distraction osteogenesis and periosteal expansion
- Research on various augmentation method for implant placement
- Research on dento-alveolar reconstruction in patients with cleft lip and/or palate
- Research on pathophysiology of temporomandibular joint disorders
- Research on treatment modalities for facial trauma
- Basic and Clinical research on bone substitute
- Research on control of growth and invasion, and surgical reconstruction of oral tumors.
- Development of bone substitute with bone forming property
- Development of dental implants with bone forming property
- Diagnosis and Surgical simulation in patients with jaw deformities using 3D CT/photo
- Dento-alveolar reconstruction using Tissue Engineering



Before bone graft



After bone graft



After dental reconstruction

A case of dental reconstruction after bone grafting to the alveolar cleft in a patient with cleft lip and palate.

Dento-oral Anesthesiology

Professor Eiji Masaki

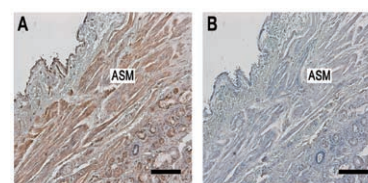
The purpose of research activity in our division is focused on removal of any hardship in patients undergoing surgery and dental procedure. Control of pain, avoidance of medical complications, and offering comfortable environment for treatment are included in this purpose. The results of our study could reduce cost of medical treatment as well as improve quality of life of patients.

Main research themes

- Clarification of pain regulatory systems in the spinal cord
- Development of new therapeutic modalities for intractable pain including postoperative pain
- Development of new therapeutic approaches for bronchial-spasm and asthma
- Investigation into lung epitheliums with regard to therapies of COPD



Evaluation of heat stimuli evoked responses in a postoperative pain model



Immunohistochemical staining of dopamine D1 receptor in human trachea. (A) Expression of dopamine D1 receptor on airway smooth muscle (ASM). (B) Negative control.

Craniofacial Engineering and Regeneration

Craniofacial Development and Regeneration

Professor Yasuyuki Sasano

We have been investigating development, regeneration and healing of bones and teeth using rat experimental models. In particular, we are interested in regulatory mechanisms of extracellular matrices on cell and tissue differentiation in the calcified tissues.

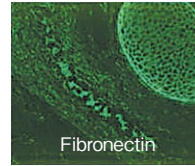
Main research themes

- Regulatory mechanisms of extracellular matrices on differentiation of osteoblasts, chondrocytes, cementoblasts and odontoblasts
- Remodeling of extracellular matrices in the calcified tissues during development, regeneration and healing
- Differentiation and maturation of cells and extracellular matrices in the calcified tissue during development, regeneration and healing
- Regulatory mechanisms of calcification

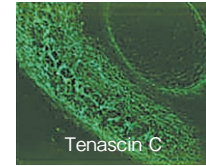
E15 Rat Mandible



TYPE I Collagen



Fibronectin



Tenascin C

Expressions of extracellular matrix molecules in a rat embryonic mandible

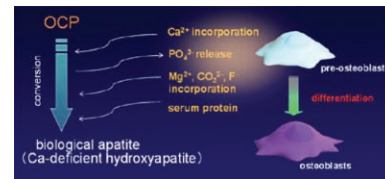
Craniofacial Function Engineering (CFE)

Professor Osamu Suzuki

We are focusing on the fundamental science and the applied research of tissue engineering with the biomaterial science and biology to investigate about regeneration of various bone defects in the fields of dentistry, oral surgery, and an orthopedic surgery. Especially, we are developing new functional biomaterials and new devices based on biomimetics.

Main research themes

- Bone regeneration using the synthetic octacalcium phosphate (OCP), which is originally developed in our laboratory and becoming clear to be replaced to hydroxyapatite (HA) spontaneously when implanted in vivo
- Device development of the controlled release of the growth factors which reproduce bone and periodontal tissues
- Surface designing of the metal implants using calcium phosphates to increase bone regeneration capability and mechanical adaptability
- Elucidation of biomineralization and its application to bone regeneration using synthetic or natural polymer carriers
- Development of the drug and the gene delivery methods utilizing the synthetic calcium phosphates and translational research into bone regeneration field
- Micro-nano manipulation technology in cell culture and examination using tissue engineering methods
- Development of the method to evaluate bone quality of the regenerated bone tissue



The bone regeneration research using the originally developed artificial material (synthetic octacalcium phosphate (OCP)) to induce differentiation of osteoblastic cells and analysis of bone regeneration mechanisms.



Development of the culture device to load a mechanical stress on osteoblasts and chondrocytes. Analysis of stem cell differentiation process into osteoblasts and chondrocytes using the micro-nano manipulation technology.

Liaison Center for Innovative Dentistry

Liaison Center for Innovative Dentistry

Center director Keiichi Sasaki

In the dentistry of a new century, the pioneering researches should be done by mutual collaboration with the researchers of other fields, and the contributions both inside and outside of the country are demanded. The Liaison Center for Innovative Dentistry promotes advanced dental research, interdisciplinary integration research, and industry/academic /government collaboration, and coordinates these research activities in the dentistry of a new century for realization of contributions within both regional and international society through educations, researches and clinics.

Main project contents

- Promotion of international interdisciplinary integration researches regarding interface oral health science (Integration Research Section)
- Research and development for the new medical devices and biomaterials to realize healthy society of longevity (Integration Research Section)
- Research and education related to reconstruction after earthquakes, disaster prevention, and rehabilitation of Japan (Integration Research Section)
- Development and management of the curriculum for international cooperative education (International Cooperation Section)
- Development and operation of regional cooperative education, clinical supports, and social contribution programs (Regional Cooperation Section)
- Research of social capital within regional and international society (International Cooperation Section, Regional Cooperation Section)

Molecular Pathogenesis of Oral Tumor

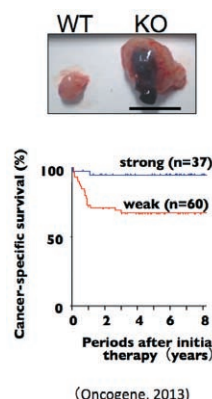
Oral Cancer Therapeutics

Professor Hisanori Horiuchi

Small GTPases function as molecular switches in cell proliferation, cell movement and intracellular traffic. We are investigating roles of small GTPases in oral cancer proliferation, invasion and metastasis. Bisphosphonates are used for the therapy of osteoporosis by inhibiting lipid modification of small GTPases in osteoclasts. We are also investigating about the posttranslational lipid modification.

Main research themes

- Regulatory Mechanism of Oral Tumor Proliferation, Invasion and Metastasis by Small GTPases
- Research on Lipid Modification of small GTPases



We have discovered an inhibitory regulator of small GTPase Ral, RalGAP. In its KO mice, chemically induced bladder cancer were large and with high malignancy, compared to wild type (WT). Then, human bladder cancer with weak expression of RalGAP exhibited poorer prognosis compared to that with stronger expression. Thus, RalGAP could inhibit bladder cancer progression.

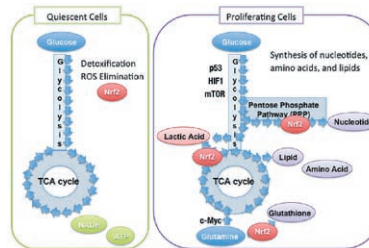
Molecular Oral Oncology

Professor Hozumi Motohashi

Squamous cell carcinoma (SCC) is the most common type of oral carcinoma. In many human cancers including SCC, aberrant activation of a transcription factor Nrf2 has been detected, which strongly correlates with the poor clinical outcome. We are working on the role Nrf2 plays in cancer cells. Our goal is to clarify the molecular mechanisms underlying the malignant evolution of cancers.

Main research themes

- Roles of Nrf2 in Cancer Initiation and Promotion
- Stress Response Mechanism and Metabolic Reprogramming in Cancer Cells
- Intracellular Redox Homeostasis and Genome Protection in Carcinogenesis



Nrf2 is a key regulator of cytoprotection against oxidative and xenobiotic stresses. In cancer cells, Nrf2 acquires the additional ability to enhance metabolic reprogramming and promotes cell proliferation.

Intractable Diseases and Immunology

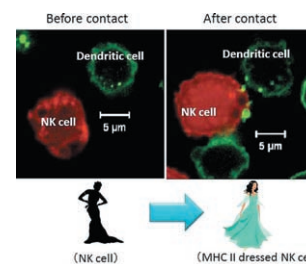
Intractable Diseases and Immunology

Professor Koetsu Ogasawara

Refractory systemic diseases often show initial lesions in the mouth. However, the relationship between intractable diseases and the onset of lesions in the oral cavity is not well understood. In our laboratory, we examine the immune responses related from oral diseases, to elucidate the pathogenesis of intractable diseases.

Main research themes

- Dressed NK cell
- Immune surveillance against tumor
- Metal allergy
- Viral immunity
- Autoimmune diseases



MHC II dressed NK cells (Photo)
NK cells (Red) acquire MHC II (Green) from Dendritic cells.

Advanced Biomaterials

Advanced Biocompatible Materials

Professor Takashi Goto

This laboratory is engaged to create novel bio-integrated materials and hybrid artificial tissues for hard tissue regeneration by developing physical/chemical surface modification processing.

Main research themes

- Development of high strength, ductility and water-holding bio-integrated materials
- Development of surface modification processing to improve tissue cell adhesion with titan and hydroxyapatite
- Development of high cell adhesion, water/heat-holding and machinable hybrid artificial tissues

Advanced Biofunctional Materials

Professor Mitsuo Niinomi

Our department conducts research on the development of biomaterials with functionality similar to body tissues and promotes and activates gain-of-function of regenerated tissue.

Main research themes

- Development of biofunctional materials such as dental implants and artificial bones harmonized with biofunction
- Development of biofunctional materials with mechanical and biological properties as well or better than those of body tissues
- Development of high functional materials supporting the biofunction lost by disease

Bio-Dental Engineering

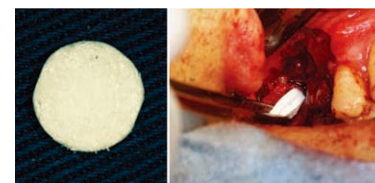
Bio-Dental Engineering

Professor Shinji Kamakura

Teeth are worked enough when the root of a tooth is surrounded by intact bone tissue. If the bone around the teeth were broken by suffering oral and dental diseases, such as periodontal diseases, congenital anomalies, and jaw tumors, several problems including masticatory disturbance would be evoked. The division aims to regenerate bone that was lost by oral and dental diseases with applying biomaterials, and recover the functional disturbances. Furthermore, the division has managed both basic and applied research with considering a low-burden treatment for patients.

Main research themes

- Bone regeneration by octacalcium collagen composite
- Establishment of a new animal model for bone regeneration
- Research for quantification of regenerated bone tissue



Clinical trial of octacalcium collagen composite

Redox Regulation

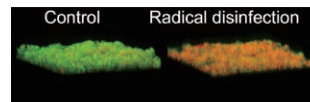
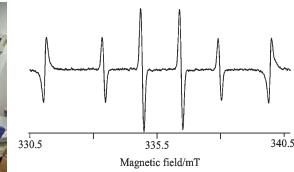
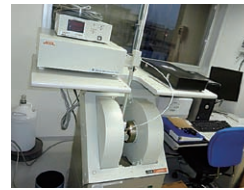
Laboratory for Redox Regulation

Professor Yoshimi Niwano

To elucidate *in vivo* behavior of reactive oxygen species (ROS) and free radicals accompanied by electron transfer in molecules that constitute living organisms such as lipid membranes, enzymes, and nucleic acids is an important subject in life science. In addition, control technology of ROS and free radicals is one of the important subjects in the medical field. In our laboratory, a wide range of research covering not only the medical field but the agronomy and engineering fields are conducted by applying control and analysis techniques for redox reactions.

Main research themes

- Basic and translational research on laser-excited radical disinfection technology
- Interaction of oxidative stress and antioxidants



Free radicals can be determined by using an electron spin resonance spectrometer. Microorganisms in biofilms are effectively killed by the radicals.

Next generation Dental Materials Research

Next generation Dental Materials Research

Professor Keiichi Sasaki

In our research of dental equipment and materials, our aim is to deliver a healthy society for our ageing population by ensuring that diverse innovative new technologies that lead the way in the reform of clinical practice are promptly applied in the field of dentistry and used in clinical applications. We will analyze the basic technical properties of dental equipment and materials for reconstruction of lost teeth and bone tissue, and we will study the design, processing and biological safety of materials including their ability to function as intermediate materials. We will also develop mandatory test methods to ascertain the long-term durability of the materials themselves in the oral environment so that they can continue to function and maintain their shape when used *in vivo*.

Main research theme

- Research of materials for dentures and dental restorative materials that can contribute to oral health care, and an evaluation of their technical characteristics

Immune Regulation and Oral Immunity

Immune Regulation and Oral Immunity

Affiliate Professor Satoshi Takaki

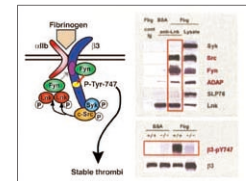
The oral mucosa is a front line of host defense system against microbes and hazardous antigens. It also becomes targets of inflammation caused by autoimmune or allergic responses. Immune regulation of oral immunity is critical issue to control infections and keep Quality of Life (QOL) of disease patients. We are investigating, 1) Signal transduction and regulation by microenvironments operating in the host defense system, 2) Mechanisms for the production of autoantibodies involved in the disease development and maintenance of autoimmune disorders including Sjögren syndrome, 3) Regulations for the maintenance and expansion of tissue stem cells, to manipulate and regulate immune responses in oral mucosa.

Main research themes

- Signal transduction and regulation in humoral immune responses
- Mechanisms for the generation and function of auto-antibodies involved in various autoimmune diseases
- Development of methods for manipulating or reconstituting the immune system



Lymphocyte progenitor cells growing on bone marrow stromal cells



A newly identified regulation by Lnk adaptor protein in signaling through integrins

Geriatric Oral Science

Geriatric Oral Science

Affiliate Professor Kenji Matsushita

Affiliate Professor Shumpei Niida

Japan has the highest longevity in the world. Maintaining the quality of life (QOL) of elderly is important for each individual and society. Our department conducts research on the molecular and cellular biology of bone and joint diseases (including alveolar bone and the temporomandibular joint) that lower the QOL of the elderly, and basic and clinical research on caries and periodontal disease causing tooth loss from the viewpoint of vascular biology and bone metabolism.

Main research themes

- The role and application of nitric oxide in the periodontal tissue
- Diagnosis and control of the periodontitis
- Exploratory research of the aging and disease related biomolecule by Omics analysis

Entrance Examination Guide, Graduate School of Dentistry

Selection procedures

	General screening	Special screening for working students	Special screening for foreign exchange students
Master's course	Evaluation based on: Score on written examination (English and short essay), interview and transcript	Evaluation based on: Score on written examination (short essay), interview, transcript and statement of motives for applying	Evaluation based on: Score on written examination (short essay) and transcript
Doctoral course	Evaluation based on: Score on written examination (English, specialized subject), interview and transcript	Evaluation based on: Score on interview, transcript and statement of motives for applying	Evaluation based on: Score on written examination (specialized subject) and transcript

Qualification Screening

Applicants who graduated from foreign universities have to undergo the qualification screening for application in advance. Please contact us by e-mail before the beginning of qualification screening, if applicants want to obtain more detail information.

e-mail: den-kyom@bureau.tohoku.ac.jp

Examination schedule

		Qualification Screening	Period of application	Examination date	Announcement date of examination results
Admission in October 2013		May 27 - 31, 2013 (Mon.-Fri.)	June 17-21, 2013 (Mon.-Fri.)	July 8, 2013 (Mon.)	July 18, 2013 (Thurs.) 10:00 am (Planned)
Admission in April 2014	First Recruitment	May 27 - 31, 2013 (Mon.-Fri.)	June 17-21, 2013 (Mon.-Fri.)	July 8, 2013 (Mon.)	July 18, 2013 (Thurs.) 10:00 am (Planned)
	Second Recruitment	October 28 - November 1, 2013 (Mon.-Fri.)	Nov. 25-29, 2013 (Mon.-Fri.)	Dec. 17, 2013 (Tue.)	Jan. 16, 2014 (Thurs.) 10:00 am (Planned)

Number of new students enrolled based on former universities/selective classification

Curriculum • Year of enrollment		Tohoku University graduates		Other university graduates		Foreign exchange student special screening	Total
		General screening	Special screening for working people	General screening	Special screening for working people		
Master's course	2013	—	—	1	5	0	6
	2012	—	—	0	4	0	4
	2011	—	—	0	5	2	7
Doctoral course	2013	17	4	7	3	5	36
	2012	9	5	15	5	3	37
	2011	20	2	12	7	2	43

Admission Guide, Graduate School of Dentistry

Mandatory fees

Admission fee: ¥282,000

Tuition (first half-year): ¥267,900 (annual amount: ¥535,800)

These amounts are subject to change, and if the entrance fee or tuition fee is revised at the time of entrance or during enrollment, the new amount will be applied at the time of the change.

1 Admission fee and tuition exemption

When a student has extreme difficulty in paying the admission fee or tuition because of financial reasons, and the student is recognized as excellent, upon the student's request, the admission fee or half or all of tuition may be exempted. For more details, please refer to the Admission Procedures Information Sheet.

2 Japan Student Services Organization Scholarship

The Japan Student Services Organization Scholarship provides scholarships to excellent students who have financial difficulties in paying school fees. The amount provided per month (for new students in 2012) is the Daiichi Shogakukin/No.1 Scholarship (interest-free): ¥88,000 for the Master's course and ¥122,000 for the Doctor course.

The Daini Shogakukin/No.2 scholarship (interest-free): choice of ¥50,000, ¥80,000, ¥100,000, ¥130,000 and ¥150,000. It is possible to combine both No. 1 and No. 2 scholarships. Students who display excellent performance have a chance to receive the First Repayment Exemption Scholarship. Besides the Japan Student Services Organization Scholarship, there are scholarships given by private foundations and local governments.

3 Japan Society for the Promotion of Science Fund

A Special Researcher Program is available for excellent students, supported by the Japan Society for the Promotion of Science. At the beginning of the course, to help people concentrate on life as a researcher and to choose a field and place of research with a free, unencumbered mind, grants of ¥200,000 for students in the Doctoral Course and ¥364,000 for students who complete the Doctoral Course (post-doc) will be granted.



Tohoku University Graduate School of Dentistry Building for Basic Dental Science (left), Building for Clinical Dental Science (right).



ACCESS

Transportation from JR Sendai station
By Sendai city bus:

From JR Sendai Station West Exit bus stop **13**
Take the bus bound for Sakuragaoka 7-chome via Yamate-machi,
get off at **Shigaku-bu • Tohokukai-byoin-mae (Dentistry • in front of Tohokukai Hospital)**

From JR Sendai Station West Exit bus stop **14**
Take the bus bound for Kitanakayama • Nishi-nakayama via
Kitayama Tunnel • Nakayama Bound for Sumiyoshidai •
Nenoshiroishi via Kitayama Tunnel • Nakayama • Izumi Village,
get off at **Shigaku-bu • Tohokukai-byoin-mae (Dentistry • in front of Tohokukai Hospital)**

From JR Sendai station West Exit bus stop **25**
Take the bus bound for Sihei-machi–Kitayama-Junkan (circle) via
Aoba Dori (street)•Daigaku-byoin, get off at **Shigaku-bu • Tohokukai-byoin-mae (Dentistry•in front of Tohokukai Hospital)**

By subway:

Get off at **Kita Yoban-cho station**, North No. 2 Exit and walk
toward Hachiman-machi for 10 minutes.

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