

# Teeth

Healthy teeth, healthy body

On toothache and other pains

Implants, bridges, crowns

Masticating machines

Computer-aided beauty

Tooth trauma – saving solutions

Teeth that fit – a matter of balance

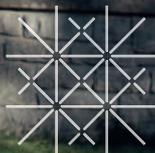
Oral mucosa – an early warning system

Too little spittle

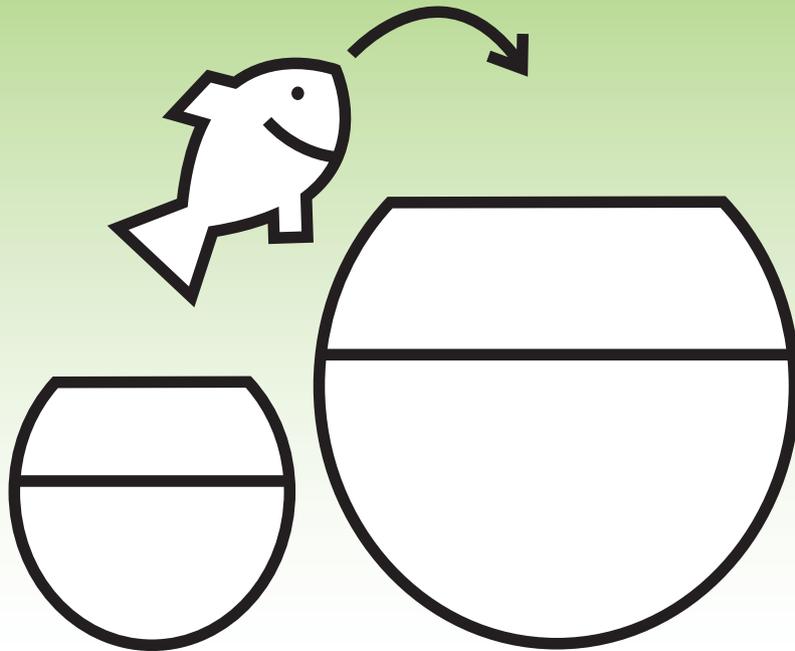
On self-consciousness

Fossil forensics

Microfilm archive – keeping scores



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**Biting and chewing**

Our teeth – secured in our mouths by tiny microscopic fibers connected to the root and bone. These fibers are grouped together in bundles producing a crest formation. Since they are required to withstand pressure from extreme forces, our teeth have elastic properties allowing them to bend under strain. Throughout our entire lives, a prodigious effort is expected of our teeth: every single day we use them to bite, to chew, to speak. We show them off when we smile and wear them away by grinding in our sleep. Despite our regular brushing, they often give us cause for concern and produce pain. Once our baby teeth have been superseded by adult teeth, the dentist begins to correct, to repair and restore, to enhance and replace. Healthy teeth are considered a sign of beauty; damaged teeth can often affect the health of the whole body. The most common source of damage is dental caries, a progressive infection caused by streptococci. These bacteria convert sugar and the remains of food into acid, which then attacks and destroys the dental enamel. Today, large sections of our population are affected by dental caries.

In this issue, our spotlight falls on experts from the School of Dental Medicine at the University of Basel who report on research and on developments in their field. Scientists, too, play a role in the treatment of teeth continually proposing new methods and producing new materials. Naturally, cutting-edge technologies and digitalization have now become a permanent fixture in the field of dental medicine: computers enable three-dimensional imaging of the mouth and the virtual planning of fillings, bridges and implants. Researchers are engaged in a constant search for new wisdom regarding our teeth.

Christoph Dieffenbacher, Editor UNI NOVA

P.S. Starting with this issue, UNI NOVA will also be available in English. This gives us the opportunity to address a growing audience of English speakers with an interest in science and research at the University of Basel. Subscribers who wish to receive the English rather than the German edition should let us know using the address listed in the imprint. And, UNI NOVA is now climate neutral, which means that the CO<sub>2</sub> emissions produced in printing are offset by climate protection projects

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**Cover page and photography sequence**

The cover photo and the sequence of photos in the focus section were taken by Basel photographer Ursula Sprecher. Her contribution to this issue shows objects that have some connection either in form or function to teeth or to toothed structures.



### Teamwork and job rotation

In the past few years, many companies have switched to new ways of working, such as decentralized decision making, teamwork and job rotation. Whether the first companies to introduce such innovations have an advantage is the focus of research by Professor Michael Beckmann and Kathrin Armbruster from the Faculty of Business and Economics at the University of Basel. Result: early introduction of teamwork produced only slightly positive effects, primarily because the concept was already relatively well established in the companies. By contrast, the impact of the late introduction of job rotation was clearly negative; this was due, above all, to the fact that job rotation is a more complicated concept to implement. The timing of the re-organization can, therefore, have both a positive and a negative influence on company performance, whereas early introduction appears to be more advantageous. In general, it can be concluded that the quality, as well as the quantity, of reorganization has an effect on company success. The effects of the time at which new ways of working are introduced were investigated using two nationally representative Swiss firm-level data sets from 2000 and 2008.



### Sticklebacks and speciation

Marine threespine stickleback fish (*Gasterosteus aculeatus*) have colonized innumerable rivers and lakes throughout the northern hemisphere since the last glaciation about 12,000 years ago and have since adapted to these ecologically different habitats – a first step towards the formation of new species. Professor Walter Salzburger, Dr. Daniel Berner and Marius Rösti from the University of Basel's Department of Environmental Sciences/ Zoology have been able to demonstrate on the basis of hundreds of millions of the fish's genetic sequences, that there can be relatively strong differentiation within the genome between populations even within just a few thousand years. Furthermore, the extent of genetic differentiation between populations is mirrored in the differentiation of the phenotype. The study also points to a genome-wide characteristic pattern in the genetic differentiation between lake and stream sticklebacks: chromosomes are more strongly differentiated in the center than in the peripheries. This is because there is less genetic shuffling (recombination) in the centers of chromosomes between populations, which makes them relatively more isolated than the peripheries.



### Increasing self-esteem

How do we develop self-esteem in our teenage years and young adulthood and what are the factors that influence this process? These questions are the subject of research carried out by Ruth Yasemin Erol and Professor Ulrich Orth of the Faculty of Psychology at the University of Basel. The research was based on data gathered from 7,100 people who were interviewed eight times between the ages of 14 and 30 as part of an American study. The results showed that self-esteem increases continuously during adolescence and that the trend then levels off in young adulthood. This was equally the case for men and women. Emotionally stable, extraverted and conscientious individuals displayed more self-esteem at each age. Other factors that had a positive influence on self-esteem were the feeling of being in control of one's life, a lower level of risk-taking behavior and better health. There was evidence of differences between ethnic groups: Latinos displayed lower self-esteem in adolescence than their peers from black and white ethnic groups; in this group, self-esteem did increase later, however, and much more strongly, so that at age 30 Latinos along with their black peers displayed a higher level of self-esteem than whites.

# “In the beginning is knowledge of ourselves”



Self-consciousness, understood as the awareness of oneself, should once again be promoted increasingly as a subject of reflection according to philosopher Sebastian Rödl. This awareness differs fundamentally from the awareness that we have of the world. Interview by Christoph Dieffenbacher.

**How is the term ‘self-consciousness’ understood by philosophers?**

It is the starting point, and, indeed, the core of the discipline. A basic human need is to understand and perceive oneself, or rather to understand and perceive at all. It originates in human life. I believe that the desire to understand oneself forms the basis of every understanding, and thus also underlies every human community. In philosophy, reflection on an awareness of oneself has fallen out of regard.

**Is there a difference between knowledge of oneself and knowledge of the world?**

We learn about the world through our senses and through observation. With ourselves it is different: we don’t learn about ourselves by looking from the outside; the fundamental source of our knowledge about ourselves lies within us, in fact in what we do. If you do something consciously, you usually know what and why you are doing it. You know, because you are acting. In general, the existence of a creature is defined in its actions. Unlike animals, for humans the understanding of our actions is achieved through the action itself – we act according to an understanding and a general idea of what we are.

**Where does this idea come from, and how is it developing?**

In a certain sense, human self-consciousness comes from nowhere. The knowledge of myself is there because I am there; and it develops because I develop. In the same way that a small child grows ‘into’ human activities – thereby also ‘into’ the human community, it

also grows ‘into’ an understanding of itself. I believe that it is important to understand self-consciousness as something that we share with one another and not as something that divides us; after all, we act and live together.

**You use the terms ‘first and second person thinking’ – what do these mean?**

I mean the kind of thinking that is expressed linguistically through the pronouns ‘I’ and ‘you’: in individual and in joint activity. That which is expressed in the first person is our own thinking and actions; second person thinking relates to our living together. For me, the ‘you’, the other person, is different to any given object that I recognize. Knowledge about the ‘you’ comes from joint activity. We are quick to adopt an objectifying notion of people in the same way that scientists claim to do so, with the help of brain scans ...

**... but who then also lay claim to expert knowledge about people.**

It is an illusion that we, as self-conscious beings, might discover by empirical means something fundamental about ourselves. Scientists and psychologists can make limited statements about human existence; however, these statements do not come close to answering the essential questions – the questions about the essence of our being. This is the job of philosophers. To live as a human means to strive to understand oneself. In this respect, we remain a mystery to ourselves: Socrates knows that he does not know, and we cannot do any better. We should take our mysteriousness seriously.

Professor Sebastian Rödl, born in 1967, was Professor of Philosophy at the University of Basel from 2005 to 2012, and has held a professorship at the University of Leipzig since August 2012. Professor Rödl studied in Frankfurt am Main and Berlin; he gained his doctorate in 1997, and completed a post-doctoral ‘Habilitation’ in 2003 in Leipzig. He was then appointed associate professor at the University of Pittsburgh, and has been a visiting professor at various universities, including Chicago and New York. One of his publications is *Self-Consciousness*, Harvard University Press, 2007 (in German: *Selbstbewusstsein*, Frankfurt/M. 2011, stw 1992).



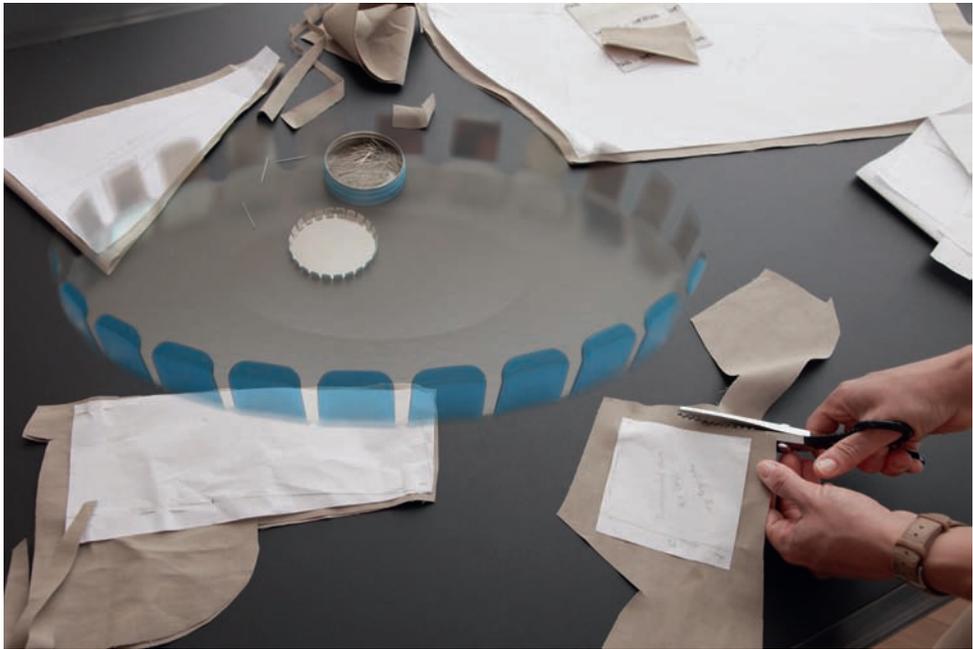














# Healthy teeth, healthy body

The tooth supporting structures ('periodontium') consist of the gum tissue surrounding the tooth ('gingiva'), the bony socket ('dental alveolus') and a special periodontal ligament ('desmodont'), which secures the tooth in the jawbone. Periodontal diseases affect almost all of us – often with consequences for our general health. Clemens Walter, Nicola U. Zitzmann

Periodontal diseases can have a variety of causes. In most cases, however, the primary cause is an infection due to bacteria found in the dental plaque (also known as 'biofilm'). Poor oral hygiene encourages the collection and growth of bacteria on the tooth surface. There is also a range of risk factors that encourage disease development and, equally, have a negative influence on the manifestation of the disease. Risk factors include smoking (cigarettes in particular), metabolic diseases such as diabetes mellitus, certain genetic predispositions, or challenging situations in life, for example, long-term stress at work or in our private life. If we neglect our oral hygiene for just a few days, a superficial inflammation of the gum tissue can develop, known as 'gingivitis'. This is, however, reversible: once the biofilm has been permanently removed, the inflammation of the tissue can be completely resolved. The symptoms of gingivitis are usually manifested as redness, swelling and bleeding gum tissues.

## Periodontal pockets

If the inflammation persists, deeper areas of the periodontal apparatus will be affected. Once the inflammatory processes affect the jawbone and bone tissue is destroyed, the clinical diagnosis is periodontitis, which can often leave visible signs of damage. The result is the development of a diseased cavity between the gum tissue and the tooth, a so-called 'periodontal pocket' that can no longer be accessed by the patient during normal oral hygiene routines. More and more bacteria collect there, the inflammation continues to spread and the pocket becomes deeper. Pockets that extend to 6 millimeters or more in depth are especially critical, since at this depth crevices can develop which harbor particularly aggressive bacteria. Hard calcium deposits, such as calcified plaque/calculus and subgingival tartar (invisible deposits in the periodontal pocket) are very problematic since soft bacterial plaque adheres particularly well to these rough surfaces. Periodontal disease that remains untreated can result in the loss of a tooth.

It is important to note that the German term 'parodontosis' describes a regression of the gums due to advancing age and cannot usually be prevented. This no longer corresponds to the current understanding of the disease. 'Parodontosis' is an obsolete term, now only used as a purely historical reference.

The answers to some simple questions can help to identify the disease and determine whether treatment is required: Do I suffer from bleeding gums? Do I have a bad taste in my mouth or bad breath? Have my teeth moved position or do they 'wobble'? Are my gums receding or do I have gaps in between my teeth that look like small black triangles? If the answer is 'yes' to one or more of these questions, in all likelihood you have a periodontal disease and a specialist examination should be carried out.

Current scientific studies focus on investigating the effects of diseases of the oral cavity, such as periodontitis, on general health. These investigations are based on two significant biological correlations: periodontal tissue is exceptionally well supplied with blood, and, therefore, bacteria in the oral cavity flora can enter the blood supply very rapidly. This so-called 'bacteremia' (bacteria in the blood) does not necessarily remain limited to the oral cavity, but can affect the entire blood flow system. This means that bacteria from the oral cavity could have a damaging effect even on distant organs such as the heart or the kidney. If all 28 teeth in the human mouth are affected by periodontitis, the area of bacterial infection will be about 100 square centimeters in size – approximately equivalent to the surface of an adult's palm. Such a large infected area does not remain unnoticed by the body's immune system and will cause a pronounced reaction involving numerous defense cells and chemical messengers. Consequently, the inflammatory process is not restricted to the oral cavity, but can attack the entire body. Untreated periodontitis increases the risk of cardiovascular diseases, such as arteriosclerosis, or a heart attack. Further

studies have demonstrated that periodontal disease can also have an effect on a pregnancy or on infant birth weight.

The Department of Periodontology, Endodontology and Cariology in Basel provides treatment for patients with periodontal disease either by specialists, dentists specializing in periodontology or students on clinical courses. Students are closely supervised by experienced dentists, which means that treatment takes longer but can be offered at a lower cost. For a considerable number of people, this is often the only affordable way to receive treatment.

### Daily teeth brushing

Periodontal therapy begins with an extensive evaluation of individual risk factors for the particular disease. An exact measurement of periodontal pockets at the base of each tooth forms a significant part of the diagnosis. Success of the treatment initially depends on optimal daily teeth cleaning. Effective tooth brushing requires a large degree of manual dexterity and cooperation on the part of the patient. An important aspect of periodontal therapy is, therefore, to provide the necessary motivation for and explanation of adequate and effective oral hygiene. This involves adapting the patient's existing oral hygiene habits, for example by teaching a different method of brushing teeth, using interdental brushes or switching to an electric toothbrush. The techniques should be adapted to suit each individual patient.

Smoking increases the risk of losing teeth as a result of periodontitis. The likelihood of developing severe periodontal disease increases with the length of time a person smokes. Consequently, programs to help patients quit smoking are an essential component in contemporary treatment approaches. These programs are often offered in cooperation with local advisory centers or local hospitals and medical practices.

The goal of periodontal treatment is to eliminate the inflammation and thus reduce the extent of the periodontal pockets. Bacteria must be removed from the tooth surface and from the gingival pocket, the calculus is scraped off and the root surface is planed. Often a combination of electronic instruments, for example an ultrasonic scaler, and specially designed manual instruments, known as curettes, is used. Treatment is usually highly successful: periodontal pockets are reduced and the negative effects on general health can be avoided. In certain cases, specialists can avail themselves of further available options to restore the health of the periodontium.

Should it nevertheless become necessary to remove certain teeth, it is possible to use dental implants as a replacement. In this case the implant primarily replaces the dental root, which is then supplemented by a crown once the healing process is complete, thus to produce a fixed restoration. It is, however, essential to realize that implants require the same intensive oral hygiene as natural teeth in order to ensure long-term stability in the jawbone. Furthermore, scientific evidence has

shown that inflammatory diseases of the implant ('periimplantitis') can develop in the same way as periodontitis. Patients with a history of periodontitis have an increased risk of the implant-supporting structures becoming infected.

### Periodontitis essentially avoidable

Periodontitis is a chronic disease. In order to prevent recurrence or further progress of the disease and to maintain long-term periodontal health, patients require the ongoing support of dental hygienists and dentists throughout their lives. Part of this process will involve the regular measuring of the depth of periodontal pockets and a systematic analysis of the various risk factors. This enables an individual diagnosis and prognosis as well as the targeted treatment of any diseased periodontal tissue when required. Periodontal diseases are essentially avoidable through individual preventative action and with appropriate dental diagnosis and treatment. Once the periodontium has become infected, early detection and treatment play a decisive role in determining whether the teeth can be preserved and also in protecting oral and general health.

PD Dr. Clemens Walter is an associate professor ('Privatdozent') and head of the postgraduate program in Periodontology (Swiss Dental Association/Swiss Society of Periodontology), Professor Dr. Nicola U. Zitzmann, PhD, is deputy head of department at the Department of Periodontology, Endodontology and Cariology, School of Dental Medicine, University of Basel.

# On toothache and other pains

Curing toothache has always been considered an integral part of the work of dentists. Yet the fact that dental practitioners have to deal with a broad range of pain types is often overlooked. Jens Christoph Türp

“It was a savage, burning, gnawing pain, a cruel torment that had spread from a diseased molar to his whole left lower jaw. There the inflammation thumped away with red-hot little hammers, leaving his face flushed and bringing tears to his eyes.” There can be no doubt that the terrible agonies endured by Thomas Buddenbrook were caused by acute pulpitis – toothache in the strict sense of the term. Our sympathy for the suffering hero of Thomas Mann’s novel only increases when we consider that in 1875, when the story is set, there was no local anesthesia as yet. Today, this sort of acute pain can be treated quickly and successfully.

## Origins of pain elsewhere

Unfortunately, the same cannot always be said of another kind of dental pain – hypersensitivity to cold or heat or sweet food. Sometimes the source of the trouble is not the tooth itself but the surrounding tissue, known as the ‘periodontium’. In this case, we talk of periodontal pain. Referred pain is particularly difficult to diagnose. It can be felt in a particular tooth, even if the cause is located elsewhere – for instance, in another tooth, in the masticatory muscles, in the temporomandibular joints, in the maxillary sinuses, or even in the heart.

Besides the teeth, the tissues most commonly affected by pain in the mouth, jaw and facial area are the masticatory muscles, followed by the temporomandibular joints. Often the cause of the trouble is strain, for example, from tooth grinding and jaw clenching (bruxism). But pain in the masticatory muscles and the temporomandibular joints can also be a regional manifestation of a general medical condition such as rheumatoid arthritis or fibromyalgia.

The common feature of all these forms of pain is that the neural pathways needed to perceive pain are intact and functioning normally. However, there is another category of pain, known as neuropathic pain, involving defective nerves. This may occur episodically, in sudden, short-lived but extremely

intense attacks – as with trigeminal and other types of facial neuralgia – or may be constant, as with phantom tooth pain, which may result (albeit rarely) from root-canal treatment or removal of a tooth. Despite the fact that the London anatomist John Hunter described this condition in detail back in the 18<sup>th</sup> century, it is unfortunately not always recognized, leading at times to the pointless and harmful extraction of healthy teeth. For that reason, it is important to heed the advice of the Breslau surgeon Carl Partsch, whose comments are as pertinent now as when they were first made in 1925: “Teeth should be removed only when it can be shown that they are diseased. Practitioners should not allow themselves to be pushed into performing an extraction just because a patient reports that pain is concentrated in a particular tooth. Extraction will not get rid of the pain; it will merely leave the patient with fewer teeth.”

Professor Jens Christoph Türp is a senior research associate at the Department of Reconstructive Dentistry and Temporomandibular Disorders, School of Dental Medicine, University of Basel.

# The artificial mouth

Damaged teeth can be restored using a variety of materials, nowadays. In the testing of these materials, machines have an important role to play, for example in experiments to simulate the effects of chewing over many years. Gabriel Krastl, Roland Weiger

Who among us would say that they enjoy slaving away in the worst of conditions? Well, our teeth have to do so: with constant exposure to moisture and considerable variations in temperature, our teeth have to chew their way through an average of 20 tons of food over a lifetime. And yet there is apparently no other part of the human body that can be lost as easily as a tooth. Replacing a tooth, for instance with an implant, can be achieved in a variety of ways. However, retaining a ‘damaged’ tooth into old age is still the preference – for a range of reasons. This is why tooth retention is at the heart of every dentist’s work.

Damage to the tooth crown as a result of caries or even an accident can be treated with a variety of restorative materials. Whereas in the past repairs were often done with metallic materials, such as amalgam or gold, nowadays more aesthetic materials on the basis of ceramics or polymers have almost completely replaced these. Modern bonding techniques enable the establishment of a secure connection between the tooth and the restoration. In the case of deeper damage, it is necessary to fix the restoration in the root canal; glass fiber reinforced posts are increasingly being used for this.

In the past few decades, a variety of modern materials have been developed. There is also a range of methods to test their performance. One such method is the so-called ‘chewing simulation machine’ – a model that, to a large extent, reproduces the natural conditions found in the mouth. Simulation experiments can be used to test restored teeth by placing them under stress from a variety of sources and from different directions. The tooth can, for example, be simultaneously rinsed with cold and then hot water. Approximately, 1.2 million chewing cycles can be simulated in just one week, which is equivalent to five years’ clinical work. Following a fatigue test of this type, the quality of the restoration margins can be analyzed under a scanning electron microscope. A durable and gap-free adaptation between the restoration and the hard tooth tissue is an essential prerequisite if the material is subsequently to be used on patients.



Restored tooth in the chewing simulator. Natural enamel cusps are used for the pressure test. The tooth is rinsed simultaneously with hot and then cold water (Image: School of Dental Medicine, University of Basel).

In addition to the fatigue test in the chewing simulator, other simulation machines can test other aspects, for example, simulating the maximum chewing force, such as when you accidentally bite on a nutshell. In this experiment, the force impacting upon the tooth is gradually increased until the tooth fractures. These investigations enable a comparison of different materials and also preparation designs as regards their ability to stabilize weakened teeth.

Resistance to wear is another important parameter. From a clinical perspective, the objective is to develop materials that behave in a way similar to natural tooth enamel. If the material is too soft, it will wear away after just a few years; whereas, by contrast, material that is too hard leads to excessive wear of the opposing tooth.

Dr. Gabriel Krastl is a senior research associate and Professor Roland Weiger is a full professor at the Department of Periodontology, Endodontology and Cariology, School of Dental Medicine, University of Basel.

# Digital beauty

An attractive, regular teeth arrangement belongs to the classical ideal of beauty. Today, reconstructive dentistry and dental technology offer numerous possibilities – indeed, in light of the opportunities offered by digital technology, we might reasonably speak of a revolution. Dominik Mahl

A well-groomed appearance with an attractive face and mouth are more important today than ever before. Modern media play an enormous role by conditioning our aesthetic sensibilities through a flood of information. Alongside the functional, biological and medical aspects of their work, dentists should, therefore, also pay particular attention to the aesthetic aspect, because in our culture a radiant healthy smile is very strongly associated with beauty and health. The field of reconstructive dentistry is characterized above all by the aesthetic reconstruction of badly damaged teeth and by natural replacement of teeth that have been lost.

The care of an edentulous, i.e. toothless, or partially dentate mouth requires appropriate examination and planning before treatment begins. A consultation will be held with the patient to discuss the expectations of the treatment. The dental technician who creates the dental prosthesis and the dental hygienist who is responsible for an inflammation free, periodontally healthy oral cavity may also be included in this discussion. Reconstructive dentistry is based on teamwork.

## Computer design rather than wax models

Dentistry today has many possibilities: discolored teeth can be lightened and brightened, decayed teeth can be treated using minimally invasive tooth-colored fillings, badly damaged teeth can be restored using veneers or crowns, missing teeth replaced using fixed partial dentures or implants, misaligned teeth corrected and edentulous jaws can be completely restored. All these opportunities are already supported or, indeed, have been replaced by digital technologies that are efficient, of high quality and comparatively inexpensive. This trend is likely to become more marked in the future.

Intraoral scanners, for example, provide instant images of prepared and unprepared teeth in the mouth. These images can be saved for future processing and can be modified and combined with other digital media such as X-rays and pho-

tographs. The (theoretically unlimited) exchange of data between the many partners in the network of a dental treatment plan is thus guaranteed.

Teeth and workpieces which until now have been manually modeled laboriously in wax can now be modeled directly on a computer screen by globally connected dental labs working with a library of tooth templates produced by computer-aided design (CAD). These objects can then be digitally manufactured using CAM in a material of choice, such as ceramic or plastic.

Increasing digitalization, specialization and globalization, and economic competition are leading to a move away from individual work by dental technicians towards milling centers which can cut any workpiece out of a pre-prepared, standardized block of material. If necessary, a local dental technician can then give this workpiece a final finish, such as a ceramic veneering or coloring.

This kind of networked workpiece manufacturing requires a new orientation on the part of the professions involved. It is in response to these new developments that digital dentistry has now been made a central theme in the basic training of dental students. They now learn about intraoral digital modeling, about the 3D planning of implants and the digitalized manufacture of CAD-CAM complete dentures. Dental technology is also experiencing a revolution with regard to digital modeling and construction.

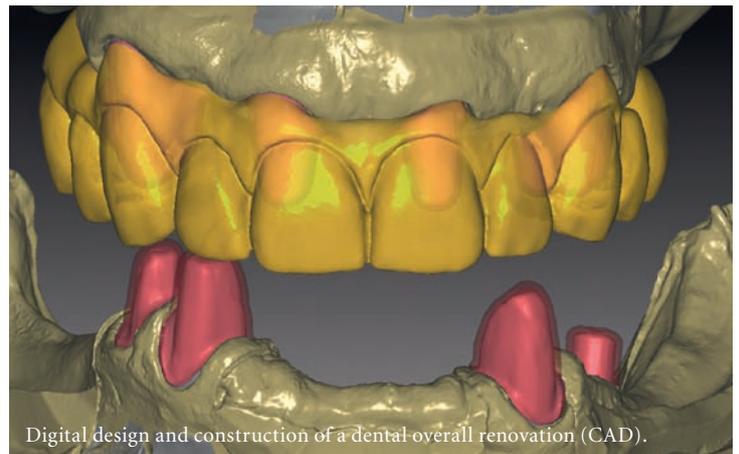
Digital technologies facilitate, for example, the copying of existing clinical situations. Assuming, for instance, that the shape and size of a provisional crown on a prepared tooth proves to be correct and is accepted by the patient, then on the basis of the digital records regarding the tooth stump and the provisional crown, a copy of the crown worn can be made by means of a digital overlay in a manufacturing software program. The permanent crown can then be milled from ceramic. Both the dentist and the patient can then be reassured that the likely treatment outcome will be as expected.

### New kinds of prosthetic restorations and implantology

According to epidemiological studies, there are still numerous patients in Switzerland who are edentulous in at least one jaw. These patients can be treated using conventional complete dentures made out of plastic or by using prostheses that are supported by implants. It is possible to manufacture the latter entirely digitally, either in plastic or in high performance ceramic – in this case zirconium dioxide. Zirconia is characterized by high levels of biocompatibility and stability, and low porosity. The milling of conventional complete dentures out of plastic is now also possible, and this leads to a greatly improved quality of the material – to accompany the cost savings.

Modern implantology is based on the concept of so-called ‘backward planning’. This means that the dentist responsible for the reconstruction shows the patient a ‘preview’ vision of the functional and aesthetic outcome of the planned prosthetic solution with implants before the treatment begins. The implant position is then determined on the basis of this preview. The actual position of the implant in the mouth is, in turn, determined using an intraoral scanner which works on the principle of optical sensors (LED or lasers) to capture and digitally model an image of the implant site. All other steps involved in providing the prosthesis such as the manufacture of abutments (connecting element) or scaffold and the actual external structure (crown or bridge) are based on this initial data. This ensures a predictable and successful outcome in the manufacture of the final product.

Clearly a revolution is currently in progress in the field of reconstructive dentistry. This will have a significant impact on the training of future dentists, on clinical and dental technician workflows, on quality standards in prosthodontics and, not least, on the structuring of the costs of dental treatment.



Digital design and construction of a dental-overall renovation (CAD).



Milling Unit (CAM) for the production of dental prostheses (Images: School of Dental Medicine, University of Basel).

Dr. Dominik Mahl is a clinical assistant professor at the Department of Reconstructive Dentistry and Temporomandibular Disorders, School of Dental Medicine, University of Basel.

# Patient models in 3D

3D technology is making great strides in dentistry. Modern techniques render it possible to produce individual patient models from three-dimensional X-ray data. Marc Zehnder, Ralf Schumacher, J. Thomas Lambrecht

The aim of imaging in medicine and dentistry is to show patients' 'real anatomy', enabling specialists to spot signs of disease so that they can make the right treatment decisions. Until now, most of the radiological images used in dental practice have been two-dimensional photographs. It first became possible to display three-dimensional images on screen at the beginning of the 1980s. These images were generated from two-dimensional computed tomography scans, but computed tomography (CT) is of only limited value in dentistry, in part because of the relatively high radiation dosage involved. Now the advent of digital volume tomography (DVT) has the potential to revolutionize the use of three-dimensional images in dentistry.

The 3D Accuitomo, a device produced by the Japanese firm Morita, was used to generate DVT images for a research study. Data acquisition is by means of a conical X-ray beam and a sensor located on the opposite side of the device, which are joined together and rotate around the patient's head. During this procedure, the sensor captures a large number of single images, from different directions, which are converted into image data in all three dimensions. These data can then be examined on screen in the form of tomograms.

A great deal of practice and experience is needed to interpret X-ray images of this kind. However, the human brain has a natural facility for interpreting three-dimensional images. This ability to see things 'plastically' is reflected in a number of recent developments, such as the fact that more and more films are being shown in cinemas in 3D. In medicine, it is standard practice even today for three-dimensional X-ray images (from computed, magnetic resonance and digital volume tomography) to be interpreted two-dimensionally, using tomograms. Individual patient models are designed to provide both dental practitioners and patients with a better understanding of anatomy.

## A technique from the auto industry

The goal is to be able to display individually the different structures that are visible in the X-ray image, such as teeth, nerves and bones. This task, known as segmentation, is not performed independently by the computer; rather, it is the specialists themselves who differentiate the structures, partly by hand and partly by means of grayscale shading. These data form the basis for a reconstructed three-dimensional digital image of the patient's skeletal anatomy. In the 1980s, Professor J. Thomas Lambrecht was the first to publish on the use of computed tomography data to produce individual patient models. The structures for these models were milled from a block of styrodur, employing a method known as 'rapid prototyping'. The technique has its origins in the product design industry and was first used predominantly in the auto industry.

The device used in our research, the Objet Eden 330, works by applying layers of liquid material, much like an ink-jet printer. Once a layer has been applied, it is hardened through exposure to light; a thin new layer of material is then added and the process is repeated. Individual models have the potential to improve communication between doctors and patients significantly. They can also be used to plan and simulate operations and to train students.

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# “From file to smile” – virtual orthodontics

Attractive, healthy teeth make a beautiful smile. Orthodontics is the branch of dental medicine concerned with correcting misalignments of the teeth and jaw. At the Department of Orthodontics in Basel a wide range of digital procedures are employed to this end. Denis F. Baumann

From our own experience we are already familiar with colorful dental braces and other fixed orthodontic appliances sometimes colloquially referred to as ‘train tracks’ or ‘tinsel teeth’. Technologies such as computer-aided design (CAD) and computer-aided manufacturing (CAM) have now become firmly established in orthodontics. This is good news for our communication with the smartphone and Facebook generation. There are essentially no age restrictions on orthodontic treatment.

## A tower of boxes 100 meters high

Models of the jaw are used to document and analyze the space available inside a patient’s mouth. Traditionally, the impression materials are placed in a metal tray into which the patient bites down to create an imprint of the teeth and jaws. This is then used to create a plaster model. It is usual for three such models to be created for each patient over the course of treatment. These models must then be kept stored in boxes for a minimum of 10 years after the completion of treatment. The cardboard boxes in which the three models are stored are 5 cm high. If we assume that 2,000 patients receive treatment over a 10 year period, then the boxes, if piled on top of each other, would create a tower 100 meters high – which is 5 meters taller than the tower of Big Ben in London. A digital model, in contrast, takes up approximately 2 megabytes of memory and so the 12,000 megabytes required for the 6,000 models belonging to the 2,000 patients can be stored on just three 4.7 gigabyte DVDs.

The advantages of digital models are that they require no actual storage space, they can be accessed from any computer workstation, and there is no need for storage and retrieval of the physical boxes. Moreover, digital models are not at any risk of damage, destruction or loss, and can be transmitted as simple email attachments via the internet. The disadvantages of digital models are the costs and materials needed for the IT infrastructure, the transport

to specialist laboratories and the carbon emissions that this produces, as well as lost economic revenue for Switzerland.

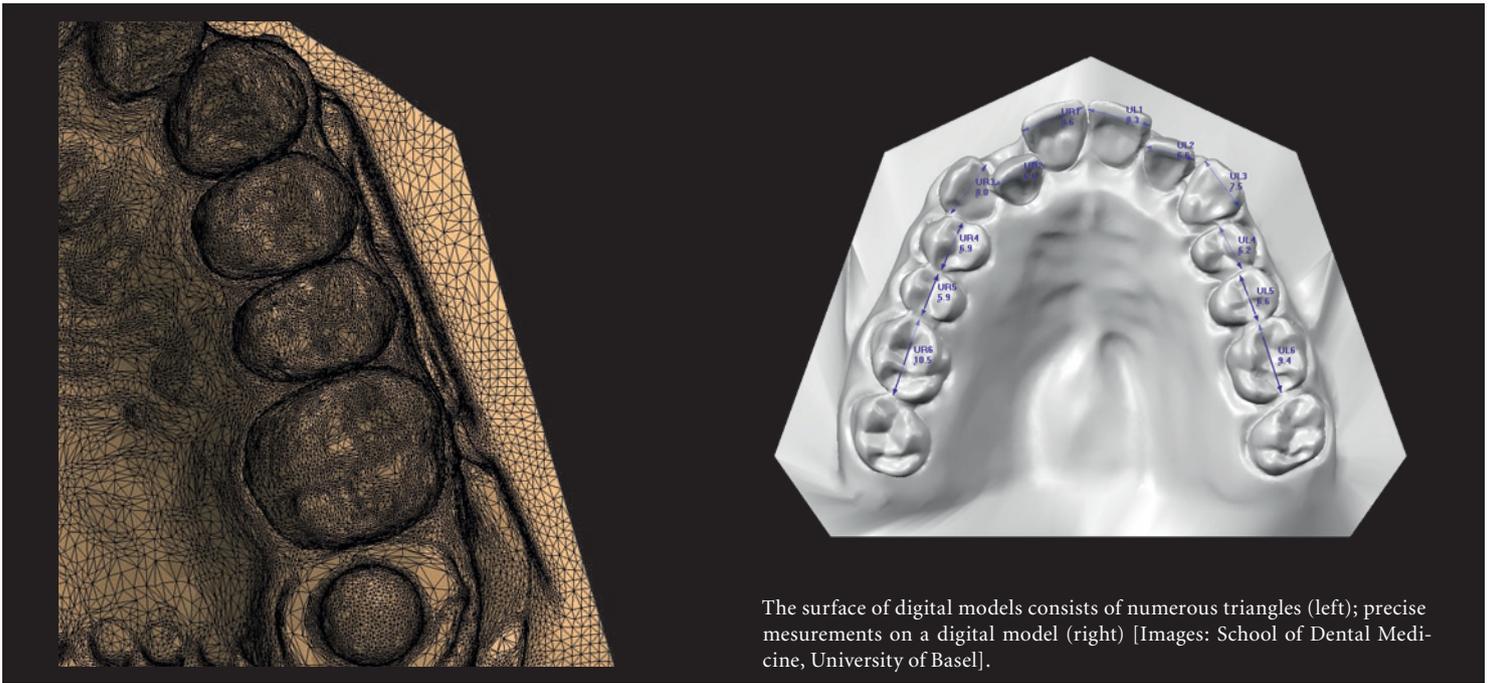
The surface of digital models is made up of a multitude of triangles. The accuracy of the model improves with an increased number of triangles per surface. Through digitalization, an analog surface is reduced to a finite number of elements. As with digital photography, the maximum possible resolution is determined by the number of points per surface. Each point is one corner of a triangle and all the triangles taken together build a network that closely represents the characteristics of the surface.

In addition to conventional scanning of the impressions and models, nowadays it is also possible to conduct intraoral optical scanning. This scan produces an instant digital model of the patient’s teeth. An application will soon be available which will allow patients to view a simulation of their future corrective treatment immediately after their teeth have been scanned. We also expect the currently bulky and heavy scanners to become smaller and, indeed, portable in the near future.

## Forces that move the tooth

The setup of the teeth requires several steps. Initially, the gums and crowns on the digital model must be separated. The planned movement of the teeth can then be created by hand using the computer mouse or by means of an algorithm.

A force as small as 10 grams is sufficient to move a tooth. Such forces are applied to the tooth that is to be moved using dental arch shaped wires made of nickel-titanium, a titanium-molybdenum alloy or stainless steel. These forces from the wire are transmitted to the teeth when the wire is fixed into brackets that have been glued to the surface of the teeth. When treating adults, the appliance may also be fixed to the inside of the tooth (lingual, in the direction of the tongue).



The surface of digital models consists of numerous triangles (left); precise measurements on a digital model (right) [Images: School of Dental Medicine, University of Basel].

Lingual systems exist in which the bracket for each individual tooth is manufactured individually using CAD/CAM technology. These brackets fit the patient’s teeth very precisely and are made from a gold alloy.

In the case of treatment using transparent aligners the tooth movement is split into small increments of approximately 0.2 millimeter per aligner. For each interim step, a model is produced by means of stereolithography or a 3D printer. Splints are then created for each model allowing the teeth to be moved in small steps.

### Nothing works without proper planning

Studies comparing the virtual setup with the clinical end result show a precision in the region of one millimeter for the virtual digital setup. This is surprising considering the fact that teeth are being moved in a biological system that can react differently for each individual. Of course the cooperation of the patient also has a great influence on the result of the treatment. Orthodontic treatment can also be planned and successfully conducted as before without virtual digital aids. The planning principally requires analytical thinking and profound knowledge of the specialist field – no computer software can replace that. Planning is a ‘conditio sine qua non’ for any treatment: “failing to plan, is planning to fail”.

Progress is happening at a rapid pace. To quote Bill Gates in *The Road Ahead*: “We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten. Don’t let yourself be lulled into inaction.” Who would have thought 25 years ago looking at the standard issue telephone that one day you would be able to use a phone to listen to music, take pictures, make films, write emails and surf the internet?

From 2009 to 2012 Dr. Denis F. Baumann completed the postgraduate program at the University of Basel’s Department of Orthodontics and Pediatric Dentistry and now works in a private orthodontic practice in St. Gallen in Switzerland.

# Implants replace dentures

The use of dental implants has developed beyond the experimental phases of the 1960s and 1970s and is now well established in modern dentistry. Current research in implantology focuses on using bone replacement materials and new implant techniques. Sebastian Kühl

A dental implant consists of a titanium or ceramic screw inserted into the jawbone. Individual crowns and bridges can be attached to this screw, just as with natural teeth. Implants can also be effective in stabilizing removable dentures. Such implants are secured in the jawbone through mechanical stability. This is further reinforced by biological stability that occurs during the period of healing in a process known as osseointegration, in which the bone fuses directly with the implant surface.

## Three-dimensional imaging

For an implant to be successful, it is essential that there is enough bone surrounding the placement site. This is usually assessed using X-rays; however, traditional X-rays show bone quantity in just two dimensions, so that the dentist is only able to judge the height of the bone available for an implant. Whilst this provides useful information regarding the depth of the implant, it offers no information about bone width. This is why three-dimensional X-rays are required, since it is important that an implant is completely surrounded by bone.

In addition to computed tomography (CT), several newer imaging techniques are available, such as digital volume tomography – here, as with CT, a three-dimensional image of the bone is produced. In some cases this can significantly reduce the X-ray dose needed as compared with traditional X-rays. This three-dimensional image allows both the height and the width of the bone to be measured accurately, meaning that implant length and diameter can be determined before any surgical intervention.

Modern processes even make it possible to plan an implant procedure virtually using a computer. The virtual plan can then be implemented on a real patient using special drilling templates. Here is how the procedure works: the dentist has a discussion with the patient about the type of dental prosthesis they would like. A temporary prosthesis designed

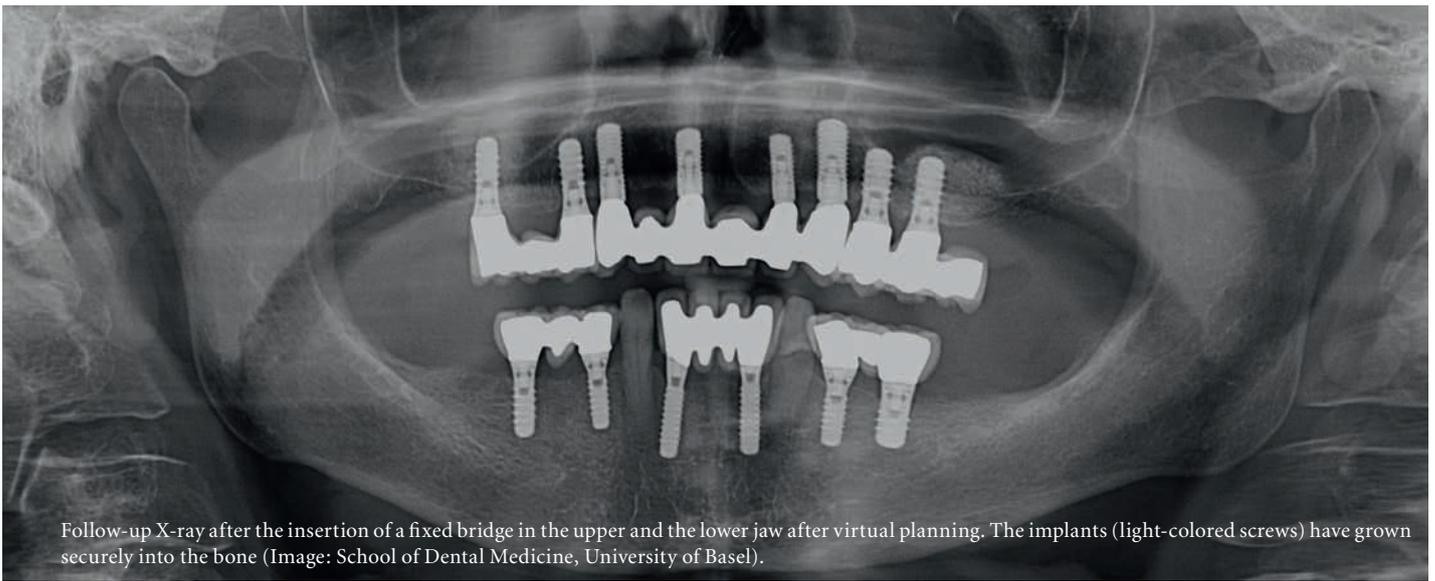
to simulate the actual implant is then constructed in a dental laboratory. This simulation is important as it shows whether there is sufficient bone available for the desired implant. This temporary prosthesis is made of a material that is visible on an X-ray. A three-dimensional scan is then carried out of the patient wearing the temporary prosthesis. The resulting image shows the position of the bone in relation to the desired implant.

## Virtual planning

Computer-based planning allows the virtual placement of an implant in its actual size in the bone. This helps to judge the best site in the bone to place the implant, or to decide whether this is even possible. Using special planning systems, the temporary prosthesis used for the X-ray can be adapted to make a surgical template, and sleeves are built into it. Once this adapted prosthesis has been positioned in the patient's mouth, the surgeon can insert the implant into the jawbone through the sleeves. The implants are then fixed in the bone exactly as planned on the computer.

In some cases, the same procedure can also be used to insert an implant through a pin-sized opening in the gum. There is no need to open up the gum any more than this or use stitches. This results in considerably less pain after the operation and also less secondary bleeding and swelling. At the Department of Oral Surgery, Oral Radiology and Oral Medicine at the School of Dental Medicine, University Hospital Basel, two different virtual planning systems have been used routinely since 2009. A major focus of the research here is on assessing the accuracy of this technology.

Should it become apparent whilst planning an implant, that there is insufficient bone available, this must be replaced before the implant is placed. Loss of bone always occurs after the loss of a tooth and mostly affects the width of the bone. Since a successful implant depends on the presence of sufficient bone surrounding the placement site, any bone loss



Follow-up X-ray after the insertion of a fixed bridge in the upper and the lower jaw after virtual planning. The implants (light-colored screws) have grown securely into the bone (Image: School of Dental Medicine, University of Basel).

must first be replaced. The preference here is to use autologous bone, that is taken from the patient's own body, either from the hip or from the mouth region. A bone transplant, therefore, always requires bone harvesting. Each harvesting of bone creates a new wound, which can lead to pain, swelling, bleeding and infection.

#### Bone replacement: which material?

As a way of circumventing the problems associated with bone harvesting, bone replacement materials can be used: these are materials created either artificially in a laboratory, or made from animal bone. Bone replacement materials commonly have a rough granular structure. If the granules are introduced into an osseous defect, new bone material can form in the empty spaces between the small individual replacement parts. This new bone provides the implant with mechanical and biological stability. In contrast with bone taken from the body, bone replacement materials have the advantage of being available in unlimited supply and do not have the disadvantage of the risks associated with human bone harvesting.

At the Department of Oral Surgery, Oral Radiology and Oral Medicine, University of Basel, a further research focus is the quality and application of different bone replacement materials, which are tested in experimental studies. The primary interest here is to test the biological interactions between bone and bone replacement material. Histological examination of tissue samples is carried out under a microscope and the regeneration of the bone as well as inflammatory reactions are investigated. Using special three-dimensional imaging methods (micro-computed tomography), the 3D structure of bone formation can also be represented. In addition to an assessment of the quantity of newly formed bone, the quality of the bone can also be evaluated in this process in order to assess any differences between the individual materials.

In addition to clinical research, laboratory experiments are used to test the interactions between cells and bone replacement materials. Cells responsible for the new formation of bone are applied to a variety of replacement materials. The number of cells can be counted under the microscope at different stages: after a few hours, days and weeks, to investigate how rapidly and how effectively bone cells reproduce on each of the replacement materials. Materials derived from coral – taken from the skeletons of red calcium-encrusted marine algae – or from synthetic material have proven to be particularly successful: for several years these materials have been routinely used in the clinic with great success.

Dr. Sebastian Kühl is a consultant oral surgeon at the Department of Oral Surgery, Oral Radiology and Oral Medicine, School of Dental Medicine, University of Basel.

# Testing a new material

Materials used to restore or replace teeth must fulfill a range of requirements. They should, for instance, provide stability while remaining sufficiently elastic. A new kind of hybrid material made of ceramic and resin has shown promising results.

Jens Fischer

Restorative dental treatment aims to replace lost hard tooth substance and re-establish chewing function, aesthetics, and phonetics. The demands on the materials to be used are many and varied: a material must deliver a sufficient level of strength and hardness to the restoration to withstand the forces exerted in chewing, and it must also provide a sufficient level of biocompatibility to avoid any long-term damage to tissue. Furthermore, the material must, in the interests of aesthetics, blend in harmoniously with its immediate surroundings, so that the restoration is not recognized as such when seen alongside the natural teeth.

## A union of ceramic and resin

Since they are better able to fulfill such requirements, ceramics or resins that can be colored to look like real teeth are now the materials of choice for dental restoration. Ceramics are brittle and, therefore, prone to fracture. Resins, in contrast, are not stable enough for permanent restorations but do have the advantage of greater elasticity, which renders them less brittle than ceramics. Compound materials composed of both ceramic and resin materials offer the advantages of both.

The research and development unit at VITA, a dental technology company in Bad Säckingen (Germany), has come up with an interesting approach to the manufacturing of such a compound material. Scientists there were able to press synthetic materials into a ceramic network and thus produce a hybrid ceramic consisting of an interpenetrating network of ceramic and resin. The modulus of elasticity of this hybrid ceramic lies slightly higher than that of the resin itself, but significantly lower than that of the ceramic alone. This means that the hybrid material is significantly more elastic than pure ceramic.

In cooperation with the Department of Periodontology, Endodontology and Cariology at the University of Basel, the team at the Institute of Materials Science and Technology is currently examining the extent to which this hybrid material

is suitable for clinical application. Initial in vitro investigations of strength and hardness through destructive testing of crowns have shown that the hybrid material displays a greater degree of strength than the pure ceramic that is used in this compound material. The extremely low variance in the measurement results was even more surprising. Low variance indicates a high level of predictability of strength values and thus a greater level of reliability of the material. This is because, under conditions of careful manufacturing, the key value with regard to the clinical durability of a restoration is not the average value but the lowest value achieved.

In parallel to these investigations, practical tests are conducted using machine-manufactured restorations. One particularly interesting characteristic of this material is the edge stability during machining, a stability, which stems from its special structure. The edge of a restoration can be milled much more precisely when using a hybrid ceramic. With ceramic alone, the edge splinters much more readily due to the brittleness of the material.

The properties of the material and the results of tests so far indicate that we have here a new and very promising class of materials; this justifies clinical applications which will provide answers to questions regarding the extent to which hybrid ceramics can fulfill the expectations placed on them.

Prof. Dr. med. dent. Dr. rer. nat. Jens Fischer is a part-time lecturer and scientific director of the Institute of Materials Science and Technology at the School of Dental Medicine, University of Basel. He also holds a position as head of the business unit vitaclinical at VITA, a dental technology company, based in Bad Säckingen, Germany.

# Action following a tooth trauma

Children and young people often knock a tooth out whilst playing games and doing sports. Since they are still in the process of developing, the treatment of traumatized teeth can sometimes be complicated. A range of new technical resources is now available to aid specialists in these complex cases. Andreas Filippi, Gabriel Krastl

In Europe, one in every two children suffers a tooth injury before the age of 16 and it commonly affects the central incisors in the upper jaw. An accident can cause teeth to either break off (fracture) or shift in position (dislocate). Following severe dislocations – when the tooth is either forced into the jaw, or is knocked out – the lifespan of the tooth is notably reduced. This causes significant problems in children and young people, as options available for teeth replacement, such as bridges and implants, cannot be provided to those who are still growing. Furthermore, recent studies suggest that implants for those under the age of 25 should not be provided to replace teeth that are visible when a person laughs.

## Complex injuries

Teeth injuries are often quite complex and can affect five types of tissue that may be damaged independently of one another, consequently requiring different treatments. These tissues include dental hard tissue (enamel, dentin and cementum); the tissues that surround and support the teeth (periodontium); the innervated connective tissue inside the tooth (pulp) as well as the jawbones and the surrounding soft tissue (oral mucosa, lips, tongue). Since these tissues fall under different areas of dental expertise, the University of Basel has established the world's first interdisciplinary Center for Dental Traumatology where patients with teeth injuries are diagnosed and treated using an interdisciplinary approach.

If a permanent tooth is knocked out, treatment must be sought as soon as possible, as cells on the root surface die quickly; these are vital for the tooth to survive in the long term. Permanent teeth that have been knocked out must, therefore, be found immediately and kept somewhere safe. The Center for Dental Traumatology at the University of Basel has designed a poster to explain to supervising adults in schools, swimming pools and sports halls what to do after a tooth accident. This includes placing the tooth in a special

cell physiological fluid as quickly as possible. The only liquid suitable for keeping a tooth for more than two hours can be found in the 'tooth rescue box', which should be available at every swimming pool and elementary school in Switzerland; nowadays, all dental practices are required to have these boxes. In the box there is a liquid organ transplant fluid that contains all the necessary nutrients and amino acids that are required to keep the cells that are necessary for tooth survival outside the mouth for over 24 hours.

If the accident happens in the evening or at the weekend, the time it takes to reach an emergency dentist may be too long for the cells on the root surface to survive, despite the tooth being stored in liquids that may appear suitable, such as milk (for a maximum of two hours), water (15 minutes), saliva (30 minutes) or saline solution (one hour). Beyond these timeframes, the tooth cannot be preserved for a longer period. If access to an emergency dentist is not possible within 24 hours, the tooth can be transferred to a new box; a tooth can be stored for two to three days in this way. The result is that all manner of serious injury can be treated initially in emergency surgery or at a children's hospital.

## Revitalized roots

The treatment of severely dislocated teeth often demands that dentists do more than simply replace the tooth in its original position, insert temporary splints and hope that it heals normally. Today, dentists also employ antiresorptive-regenerative therapy (ART), whereby the surface of the root is treated with medicines such as tetracyclines, steroids and enamel matrix proteins; these have a positive healing effect on a severely injured periodontium, and thus improve the prognosis. The younger a patient is, the more important this is.

Dislocations due to trauma usually tear the nerve (pulp) inside the tooth away from the surrounding tissue. These teeth often require root canal treatment. If this is the case,

the nerve cavities are filled and sealed with a synthetic material. This is not the perfect approach to treat pulp necrosis – especially for children between the ages of six and nine whose teeth are not yet fully developed and, therefore, still have thin root walls – and this may lead to the loss of the tooth in later life. A new procedure has recently been introduced to improve this situation, in which teeth with dead nerves are revitalized through ‘tissue engineering’. The nerve canal is cleaned thoroughly, and then a special antibiotic mixture is inserted into the root canal for two weeks in order to ensure that it is completely sterile. Following this, a specialist induces the tissues at the root tip to bleed, allowing stem cells to repopulate the root canal. If the therapy is successful, these stem cells will differentiate into cells that form the hard tooth tissue, and new tissue is generated. The tooth that was non-vital is then revitalized and its roots can continue to grow. This new therapy appears to have a 33% success rate so far. Current research results provide some hope that this significantly more ‘biological’ approach may soon replace the standard root canal treatment for immature teeth.

#### The right reaction is key

In short: Injuries to teeth can drastically affect the development of teeth and jawbones. The full extent of damage is not always clear immediately after an accident. If treated properly, teeth that have been damaged can last a very long time. However, this requires that the injured child and supervising adult – parent, teacher, lifeguard or sports trainer – take the proper course of action immediately following an accident, and that the patient receives professional treatment at the dentist’s surgery. As a rule, a dentist should be consulted after every tooth injury, even if it does not appear to be serious. The dentist will often discover unnoticeable concomitant injuries, which means that any incident that is not registered with the health insurance company may then have major financial consequences.



Histological diagram of cells that are essential for a tooth to survive (orange) on the surface of the root (black) [Image: School of Dental Medicine, University of Basel].

Professor Andreas Filippi is an associate professor at the Department of Oral Surgery, Oral Radiology and Oral Medicine, and Dr. Gabriel Krastl is a senior research associate at the Department of Periodontology, Endodontology and Cariology. Together they direct the interdisciplinary Center for Dental Traumatology at the School of Dental Medicine, University of Basel.

<http://zahnunfall.unibas.ch>

# Healthy teeth, steady steps

Older people are often afraid of seriously injuring themselves in a fall. A study conducted in Basel shows that healthy teeth can help seniors walk safely. Christina Brand-Luzi

Falls and a fear of falling are highly prevalent amongst older people, who represent a rapidly growing demographic. Each year, one in three people over the age of 65 fall and half of these people will fall several times. The result is frequently serious injury such as a hip fracture. Remarkably, the risk of dying from a hip fracture within twelve months of the accident is greater than 30%. In addition, fractured hips translate into high costs for health insurers and often into severe impairments to the quality of life for those concerned. For this reason, a great deal of medical research is concerned with ways to prevent falls. A number of studies have shown that poor balance and gait stability are significant risk factors. Healthy teeth may play a role in helping improve older patients' safety and balance when walking: the question is, to what extent?

## Balance and stability

Balance and gait stability depend on several sensory organs and their feedback to the brain. The ability to negotiate an obstacle on the ground, for instance, presupposes intact neural control mechanisms as well as reasonably strong muscles. A sense of balance is essential to knowing where our body is in space, whereas good gait stability is necessary to avoid an impending fall. As has been variously proven, healthy, correctly aligned upper and lower teeth can contribute to a person's sense of balance. Moreover, researchers have documented that patients whose brains no longer allow them to maintain proper equilibrium, such as dementia sufferers, are less likely to fall if they have teeth that fit together properly when biting down.

However, very little is known about how the gait stability of healthy, independently living seniors is influenced by their dental situation. Against this background, a study was carried out on the subject by the Department of Reconstructive Dentistry and Temporomandibular Disorders, together with the Basel Mobility Center at the University Hospital's Acute Geriatric Care Unit.

## Walking the carpet

A total of 24 patients with no natural teeth and 25 patients with full sets of teeth in both the upper and lower jaws volunteered to participate in the study. All participants were over 65 years old, had received a dental examination prior to the study, had good oral and general health, and also felt healthy. The average age of the edentulous, i.e. toothless, participants was 75 years and that of the fully dentate participants was 71 years. The test group was composed exclusively of edentulous participants, all of whom wore a full upper denture and a denture fixed onto a pair of implants in the lower jaw. The fully dentate controls either still had their natural teeth or wore crowns or bridges. All participants lived independently in their own homes and were able to walk a minimum distance of ten meters without a walking aid. To avoid false results, all were tested for conditions known to cause gait abnormalities.

Gait analysis was performed using a special carpet equipped with more than 30,000 pressure sensors. Participants were asked to walk along the carpet at a speed they felt comfortable with. All parameters under analysis were automatically recorded and the results stored. In the second phase of the experiment, participants were required to walk along the carpet while carrying a tray with a glass of water on it. The purpose of this dual task was to add difficulty for the participants and so increase the likelihood of gait problems occurring. This type of test emulates everyday situations where divided attention can lead to a fall.

## Walking speed and gait regularity

The speed each participant chose for their walk along the carpet was used as an indicator of how confident they felt walking, because the less confident a person feels walking, the more slowly they will walk so as to control their movements as best they can. There is an ample body of literature demonstrating that low walking speed correlates with a higher risk

of falling. The duration of a gait cycle in seconds is a measure of gait regularity, and the more irregular a gait is, the less safe it is. Pronounced irregularity – particularly under dual-task conditions – is another known risk factor for falls.

The study found that, under both normal and dual-task conditions, the test group's gait stability, measured in terms of walking speed and gait regularity, remained constant irrespective of whether the participants were wearing their dentures. These findings confirm other studies concerned with equilibrium, which have found that edentulous patients' balance performance did not vary depending on whether they were wearing their dentures. However, in the Basel study, the walking speeds of participants wearing full dentures did differ from those of participants who either were fully dentate or had received permanent restorations: The latter group fared better under both normal and dual-task conditions.

As far as can be ascertained at this point, a comparative study of the gait safety of edentulous and dentate individuals has yet to be undertaken. A number of notable studies conducted in Japan have produced similar findings with respect to balance, with edentulous participants showing poorer balance performance than dentate participants. In this case, the team of researchers pointed to a loss of sensory cells from the periodontium (tooth supporting structures) as a possible explanation.

In conclusion, it has been found that tooth loss correlates with slower self-selected walking speeds, which suggests that it does indeed have a detrimental effect on gait safety. However, further studies are needed to assess exactly how tooth loss affects healthy seniors' gait safety in everyday life.

Dr. Christina Brand-Luzi is a senior research associate at the Department of Reconstructive Dentistry and Temporomandibular Disorders, School of Dental Medicine, University of Basel.

# Oral mucosa aids early diagnosis

In dentistry, the oral mucosa merits the same degree of care and examination as the teeth since it can reveal changes associated with a range of different diseases. Irène Hitz Lindenmüller

Oral mucosa often shows signs of change in patients before anything else and can, therefore, be an important aid in diagnosing illness in the body as a whole. The early identification of a potentially serious disease at the dentist then makes early diagnosis possible – if necessary in conjunction with a biopsy, immunofluorescence test, X-ray, MRI and CAT scans, or a blood count. Early diagnosis enables early treatment, which has an enormous effect on a patient's quality of life.

The following diseases can be determined from the oral mucosa: blood-related illnesses (anemia, leukemia, lymphoma); hormonal imbalances (diabetes, Addison's disease); gastro-intestinal tract illnesses (Crohn's disease, celiac disease, Peutz-Jeghers syndrome), autoimmune diseases (Sjögren's syndrome, scleroderma, systemic lupus erythematosus, pemphigus/ pemphigoid); lung diseases (tuberculosis, Wegener's granulomatosis), oncological illnesses (metastasis, particularly related to cancer of the breast, prostate, kidney, lung or colon. In 25% of cases, metastasis in the oral cavity is the first indication of metastasizing, and in 23% of cases it can reveal an as yet undiagnosed aggressive tumor); infectious diseases (HIV and herpes viruses, tuberculosis, syphilis, toxoplasmosis); deficiency diseases (vitamin, trace elements) particularly in older patients who are missing teeth or who have badly-fitting dentures.

These illnesses may be hereditary or develop over the course of a lifetime. Symptoms may present themselves, but not necessarily. Diabetes, for example, is often diagnosed during a routine examination with a general practitioner since a patient has no or very minor symptoms. Dentists, therefore, play an important role in the early diagnosis of diabetes, even though the symptoms – fungal infections, gum disease, burning mouth syndrome and dry mouth, cracks at the corner of the mouth, slow healing wounds in general – are relatively unspecific.

Changes to the oral mucosa caused by disease vary considerably and can be identified in different areas of the oral

cavity. They may affect the gums, tongue and buccal mucosa (lining of the cheeks). The mucosa may have cornifications (white and usually painless areas), ulcerations (sore, exposed mucosa), erosions (red, painful lesions), blisters, brown spots or growths. Some medication prescribed to suppress the immune system (following organ transplants, for instance) or if a patient has epilepsy and high blood pressure can cause gingival (gum) enlargement as a side effect. An early diagnosis is crucial in preventing irreversible damage to organs that could prove fatal. Detailed questioning of the patient regarding the medication that he or she is taking and any other health issues (e.g. problems with the lungs or the skin), in combination with close examination of any changes in the mucosa, can prove immensely useful when diagnosing a patient. If no clear symptoms can be identified from the oral mucosa, a biopsy should be performed in order to rule out malignant growths. In the interests of patients, dentists should look to cooperate across disciplines and work together more closely with general practitioners, internists, dermatologists, oncologists and other medical specialists.

Dr. Irène Hitz Lindenmüller is a senior research associate and oral surgery specialist (Swiss Dental Association) at the Department of Oral Surgery, Oral Radiology and Oral Medicine, School of Dental Medicine, University of Basel.

# Mouth dryness in cancer patients

Mouth dryness is a very common problem in cancer patients and can have a dramatic impact on their quality of life. The Institute of Preventive Dentistry and Oral Microbiology has been working with two international professional organizations for many years to ensure that sufferers receive optimal, individualized care. Tuomas Waltimo, Adrian Ramseier

Mouth dryness is a widespread phenomenon. We have all experienced it, at one time or another, when put in a stressful situation, e.g. when taking exams or speaking in public. If it is a chronic condition, however, mouth dryness means significantly poorer quality of life and also poses a serious threat to oral health. In particular, it can contribute to, or aggravate, dental caries, periodontitis and diseases of the oral mucosa.

## Saliva shortages

When talking about mouth dryness, it is important to distinguish between two terms: 'Xerostomia' (from Greek *xeros*, 'dry', and *stoma*, 'mouth') refers exclusively to a person's subjective experience, whereas 'hyposalivation' (from Greek *hypo*, 'under', and Latin *saliva*, 'spittle') refers to a proven underproduction of saliva. The salivary glands normally produce approximately 500 to 1500 ml of saliva per day. However, there is a great deal of variation between individuals, and many patients suffering from xerostomia do not show hyposalivation. Conversely, a person producing an abnormally low amount of saliva may not experience any related discomfort. How a person experiences their condition depends not only on the amount of saliva produced, but also on its composition and lubricating properties.

Normal saliva has a slightly viscous consistency and keeps the oral cavity moist. An inadequate flow of saliva will lead to difficulty in chewing and swallowing, which can leave patients unable to eat dry foods without a drink of water. Sour or spicy foods produce such a strong burning sensation in some patients that they avoid them altogether. A large proportion of patients report oral pain and an impaired sense of taste. In addition, some find it difficult or virtually impossible to speak due to the tongue sticking to the roof of the mouth.

## Not a simple liquid

Saliva also plays an important role in defense against infections: a sufficient flow of saliva can wash away pathogenic

bacteria as well as their food source. In addition, saliva contains antimicrobial constituents ranging from unspecific – e.g. lysozyme, the peroxidase system and other enzymes – to specific antibodies, in particular immunoglobulin A.

Another key function of saliva is the protection of dental hard tissues, which helps prevent dental caries and erosion. As well as reducing the number of bacteria, saliva dilutes and buffers bacterial, ingested and reflux acids. Calcium and fluoride ions present in saliva can also remineralize existing defects.

Far from being simply water, saliva is a unique fluid that contains a multitude of active substances also found in the blood. For saliva to fulfill its functions, the right composition is equally as important as a sufficient supply. Both of these variables can be adversely affected by a number of different influences. Many medications have a direct or indirect impact on how the autonomic nervous system controls salivary secretion. Chemotherapeutic agents and especially radiation therapy can also cause temporary or permanent damage to a patient's salivary glands.

## Tumor patients at greatest risk

Radiation and chemotherapy leave cancer patients highly prone to mouth dryness, which is often one of the main factors affecting their quality of life. Painful inflammation of the oral mucosa, changes to taste, difficulty in chewing and swallowing as well as chemotherapy-induced nausea can lead to serious nutritional complications and may even prompt patients to discontinue treatment prematurely.

Mouth dryness is especially frequent in patients with tumors in the ear, nose or throat, who receive high-dose (50–70 Gy) local irradiation. It is also prevalent in stem cell transplant patients who undergo high-dosis chemotherapy commonly combined with total body irradiation, which is often administered as part of leukemia treatment. It is important to note in this context that such treatment will com-



pletely suppress a patient's immune system for a certain period of time, which means that pathogenic microorganisms that occur in the mouth or enter into the bloodstream can cause devastating infections.

In such cases, saliva production can remain impaired for years or even for the rest of the patient's life. Frequent checks and regular prophylactic treatment are crucial to helping the patients concerned. In Switzerland, health insurers are obligated under the Federal Health Insurance Act ('Krankenversicherungsgesetz') to cover part of the costs involved.

Before a patient commences cancer treatment, specialists will look for oral infections and, if possible, eliminate them. If mouth dryness occurs, a saliva substitute can provide some relief. Antimicrobial mouth rinses are used to aid oral and dental hygiene. Fluoridated mouth rinses and tooth-pastes help remineralize tooth enamel. Finally, individualized follow-up checks are carried out over a period of several years.

The Multinational Association for Supportive Care in Cancer and the International Society for Oral Oncology are the leading worldwide authorities in this field. For many years, the Institute of Preventive Dentistry and Oral Microbiology at the University of Basel has worked closely with both these organizations, ensuring its patient care meets the current global good practice standards.

Professor Dr. odont. Tuomas Waltimo is head of the institute and Dr. med. Dr. med. dent. Adrian Ramseier is a research associate at the Institute of Preventive Dentistry and Oral Microbiology, School of Dental Medicine, University of Basel.

# Apollonia, patron saint of dentistry

For centuries St Apollonia, a Christian martyr from Alexandria, was worshipped as the patron saint of all those suffering from toothache. Later she became the patron saint of dentistry as a whole. J. Thomas Lambrecht

The Christian virgin Apollonia is believed to have been born in Alexandria, in what is today northern Egypt, at the end of the second or the beginning of the third century, and to have died in 249 AD, during the reign of Emperor Philip the Arab. Very little is known about her life. In his celebrated church history in 10 volumes, the ‘Historia ecclesiastica’, the bishop and historian Eusebius of Caesarea (ca. 260–340 AD) cites a letter (book 6, chapter 41) from Bishop Dionysius of Alexandria to Bishop Fabius of Antioch describing the persecution of Christians in Alexandria:

*“They also seized Apollonia, an elderly virgin held in high regard, and knocked out all her teeth with blows to the jaws. Then her persecutors set up a pyre outside the city and threatened to burn her alive unless she uttered the godless words with them. But when, in response to her pleas, they released their grip on her a little, she quickly jumped into the fire and was consumed.”*

## A cruel fate

Dionysius’s letter is the only surviving contemporary source for these events. It should be noted that, in this original version, Apollonia has her teeth knocked out by blows to the jaws. This was changed in subsequent accounts, which describe her as having had her teeth pulled out by pliers. There are further variants on the story of St Apollonia’s cruel fate that differ from one another in certain details. Over time, Christian hagiographers invented more and more horror stories with which to embellish the original version. Originally, Apollonia’s patronage was limited to those suffering from diseased or painful teeth; only many centuries later was it gradually extended to dentists.

Her role as patron saint of dental patients is first mentioned in the Utrecht breviary of 1508. According to this text, while in prison following her ordeal, Apollonia prayed that all those suffering from toothache might find relief through her intercession. When her petition was heard, a voice from

heaven addressed her, saying, “O bride of Christ, God has seen fit to grant your request”. In a similar account, she is said during her martyrdom to have called out to onlookers from the stake that anyone with toothache who prayed to her would be healed.

## Tooth-pullers, blacksmiths, charlatans

It is easy to see how Apollonia acquired this status if we think about what constituted ‘dentistry’ in the past. At that time there were no dentists in the modern sense, only tooth-pullers, blacksmiths and charlatans who travelled around from village to village attending fairs, where they knocked out sufferers’ teeth. Just looking at the instruments that were in use back then is enough to make one’s hair stand on end. It is also important to bear in mind that the whole procedure was carried out without any form of anesthetic. With so many reasons to fear the tooth-puller, one can understand why people turned to heaven for help rather than submit to such torments. Those troubled by toothache sought the assistance of whichever saint had suffered the same agonies. For the common people, that was clearly the martyr Apollonia.

A Milanese lead coin from the 13<sup>th</sup> century provides the first evidence of her role as patron saint; unfortunately, this survives only as a reproduction in the coin collection of the Castello Sforzesco in Milan. It is also mentioned in the ‘The-saurus pauperum’ (‘Treasury of the Poor’), a sort of medical compendium by the physician Petrus Hispanus, later Pope John XXI (pope from 1266 to 1277). He recommends that people offer up a prayer to St Apollonia when suffering from toothache, as “whoever prays to the memory of the holy virgin martyr Apollonia will not be afflicted by toothache on that day.” In 1634, Apollonia was canonized by the Catholic Church, along with all those venerated before the 10<sup>th</sup> century. Ever since, she has been regarded as the patron saint of people with dental conditions.

### Veneration of St Apollonia in Switzerland

St Apollonia was venerated in Switzerland from the 14<sup>th</sup> century onwards. Images of the saint can be found in many cantons, including Aargau, Neuchâtel, St. Gallen, Thurgau, Uri, Zug, Graubünden, Basel, Schwyz, Obwalden, Vaud, Fribourg, Schaffhausen, Solothurn and Valais, but she was especially popular in Lucerne and Ticino. Evidence of the cult of Apollonia is abundant and widespread, even within the confines of Switzerland.

Coldrerio is a small village of barely 3,000 inhabitants in the far south of Ticino, in the district of Mendrisio. Due to its proximity to Italy, it offers some insights into how the cult of Apollonia came to Switzerland hundreds of years ago. The village is home to a little church dedicated to the saint, the Oratorio Sant'Apollonia, which is reached by a road – the Via Sant'Apollonia – that also bears her name. The path leading up to the church, which is located right next to a cemetery, is lined with chapels devoted to the stations of the cross. The church itself is closed all year round, except on special occasions like the feast of St Apollonia, which is still celebrated today. Although the cult of the saints is firmly entrenched throughout the district, where their images adorn many churches and chapels, the oratory in Coldrerio is the only church dedicated solely to St Apollonia.

In Basel University Library there is a color woodcut illustrating Apollonia's martyrdom. In this depiction, which comes from a Latin prayer book written by Brother Johann Gipsmüller at Kleinbasel's Carthusian monastery in 1473, the executioners attack St Apollonia with a hammer and chisel, knocking out her teeth piece by piece. The sun appears at the top of the picture, perhaps an allusion to the derivation of the name Apollonia from Apollo, the Greek god of light and the sun.

In the Basel Historical Museum there are three exhibits featuring representations of the holy virgin Apollonia. The first, a reliquary from the Benedictine monastery in Rheinau (1444), has been in the museum's possession since 1905. This coffin-shaped box consists of walnut wood completely overlaid with engraved and gilded copper plates, on which numerous illustrations appear.

St Apollonia is also depicted on a winged altarpiece from the Val Calanca. This late Gothic high altar from 1512, which is carved from lime wood, framed and gilded, was acquired for Basel's medieval collection in 1887, to keep it from being exported overseas. Since 1894, it has been held at the Basel Historical Museum. The altar bears the hallmarks of a Swabian school of wood carving, represented in its late phase by Yvo Strigel, that was influential in north-west Switzerland and Graubünden.

The final depiction of St Apollonia appears on the Peter Rot altar, which is located in front and to the right of the large Calanca altar in the chancel of the church of the Discalced Franciscans in Basel. This late Gothic winged altar, which is

named after its donor, a mayor of Basel, dates from around 1476–84. A total of 30 saints, including St Apollonia, are portrayed on the interior of the side panels. She can be identified on the left-hand panel, on the far left of the middle group of saints, holding in her right hand a slim pair of pliers containing a tooth.

### Devotion peaks

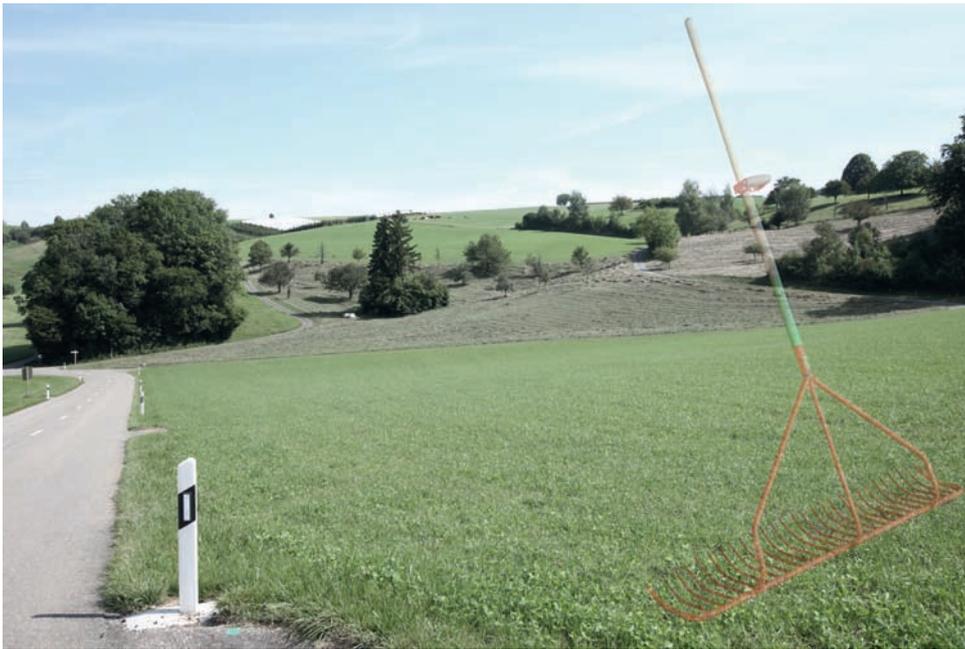
Most depictions of Apollonia in Switzerland come from the late Middle Ages and the 18<sup>th</sup> century, when devotion to the saint was at its height. The first peak coincided with the development of the concept of patron saints during the late Middle Ages, but this was quickly brought to an end by the Reformation. Under the influence of the Counter-Reformation, the Catholic Church helped the cult of Apollonia flourish once more during the Baroque period, but since then it has clearly been in decline. With the continuing development of dentistry and the establishment of the new profession of dentist, Apollonia's patronage progressively diminished in importance. By the 19<sup>th</sup> and 20<sup>th</sup> centuries, it continued to play a role only in rural areas.

Today, St Apollonia is regarded as the patron saint of dentists and of all those professions that have developed within and around dentistry. And in the conference room at Basel's School of Dental Medicine at the University Hospital, she watches over all the decisions we make for the good of our patients ...

Professor Dr. Dr. J. Thomas Lambrecht is head of the School of Dental Medicine, University of Basel.













# The mobile waste disposal of TV aesthetics



Individual communication has long since replaced classic forms of mass communication. The full impact of the overwhelming choice of media and the power of the remote control, PC and laptop is now evident: people are creating their own 'media menus' and are enjoying customized television and internet viewing schedules. In reaction to the atomization that this entails and as a way of bringing some order to the excessive daily flood of audiovisual content, a distinct collective media culture of remembering has developed. This culture is associated with the YouTube video portal, which is considered *the* video archive of the present time. Users upload their best-of music choices, commercials, favorite scenes from television shows, as well as their own clips portraying happy, sad and funny everyday experiences. What had previously only been alive in an individual's own memory, now regains its public visibility; whatever is to be remembered in the future is posted on YouTube. Around the world, approximately 60 hours of new video material are uploaded every minute. This private and public audiovisual archive of contemporary culture is supplied by media consumers and media makers alike, often in part to relieve themselves of their own archival obligations.

The younger these 'digital natives' are, the better their skills in multi(media)-tasking. Over four billion YouTube clips are watched every day, and young people often supplement their TV or computer viewing experience with a 'second screen': a cell phone or laptop for surfing the web and 'chatting' to friends about the program while watching. Smartphones and other mobile end devices make it possible

to watch any content, any time, anywhere. Media output is permanently available, but is only shown in short segments (clips) and a small format (cell phone screen). These short clips are then rendered even shorter by the will of the user, who might decide to click away after a mere 20 seconds of viewing.

A consequence of this short audiovisual format is a reduction in content and aesthetic quality: classic movie film and television formats and their stylistic features (such as fast pans, zooms and complex narrative structures) are becoming obsolete. Quotes and clips dominate YouTube. These archive materials are the foundations of image-based communication on the internet: images and sounds provide the raw material for users to edit and create new video clips independently. The result is a new form of communicative exchange aided by (moving) images, whereby clips are used to respond to other clips: they are left to speak for themselves. In this way, YouTube represents not only the vanishing point for contemporary pop memory culture, but also a site for new types of aesthetic and collective experiments.

With barely a second thought, we are leaving behind traditional categories such as author and work, genre conventions and art. In the realm of amateur design and conceptual art, media snippets disposed of by users on the YouTube platform provide the material for new duplicated, satirical or ironic compositions of image, text and sound. Their aesthetic has first and foremost a communicative function: the aesthetic quality of the scrap artwork created from media leftovers, quotations and discarded material is judged primarily by the communicative pleasure it might bring to those involved.

Professor Klaus Neumann-Braun, born in 1952, is Professor of Media Studies at the University of Basel. He studied sociology, social pedagogy, psychology, education and ethnology in Tübingen and Freiburg im Breisgau, where he gained his doctorate in 1982. He completed a post-doctoral 'Habilitation' at the University of Oldenburg in 1993, where he worked in the field of media studies. Since then, he has held positions at a variety of universities in German-speaking countries.

# A paleontological detective

Achim Reisdorf solves crimes in the field of dinosaur research. Recently, this doctoral student in Earth Sciences succeeded in unraveling the mystery of the supposed death struggle of dinosaurs. By means of a simple experiment, he and a German colleague were able to show why these creatures were often fossilized in a bizarrely twisted position. On the trail of a revealing investigation. Katharina Truninger

When you look at the bizarrely twisted position in which many fossil dinosaur skeletons are preserved – their mouths wide open, with their heads and tails pulled back behind the spine at an extreme angle – it is easy to imagine that you are witnessing their suffering at the point of death. For more than 150 years, such finds have fascinated paleontologists, giving rise to wild speculation about how the animals died. “One theory was that this bizarre twisting was caused by a form of tetanus,” the sedimentologist and fossil expert Achim Reisdorf explains. It was believed that poisoning or other damage to the cerebellum caused the dinosaurs’ muscles to tense up during their death throes, bending back the spinal column. As recently as 2007, a well-publicized US study lent support to this so-called ‘opisthotonus hypothesis’, which envisaged the animals as dying in agony.

By means of an ingenious experiment, Reisdorf and the Mainz paleontologist Michael Wuttke have now managed to disprove this theory. “We were able to show that the animals probably died in a quite unspectacular way,” says Reisdorf, with a mischievous grin. He explains matter-of-factly, “We have freed the dinos from their suffering myth posthumously, as it were.” This may sound simple, but it was in fact a long story. The host sediments in which all the fossils were found provided an important clue – the sediments were deposited underwater.

The dinosaur that Reisdorf and Wuttke selected for their case study, *Compsognathus longipes*, comes from the world-famous Bavarian fossil beds

near Solnhofen. This long-necked land vertebrate lived close to a tropical lagoon and died around 150 million years ago, ending up buried in the sediments beneath the shallow sea. The researchers suspected that the dinosaurs’ twisted posture might have something to do with the water – that they had either perished in the sea or that their corpses had been washed into the lagoon from the land shortly after their deaths. “In any case, their bodies must have sunk to the bottom of the sea quickly,” Reisdorf says.

To understand this process, the researchers resorted to a few tricks from ‘kitchen science’. They bought some chicken necks from a butcher, tied them up and put them in a plastic container that was then filled with water. As soon as the necks were fully immersed, they bent back sharply; the longer they were left there to decompose, the more they curled up. But why was this happening? Reisdorf and Wuttke found the answer in biomechanics – specifically, in a pre-stressed ligament, the Ligamentum elasticum, that runs along the spine from neck to tail. Since the ligament was under stress, it acted like a rubber band, helping to stabilize the spine.

Dinosaurs with long necks and tails needed a particularly strong Ligamentum elasticum. “It enabled them to hold their necks, heads and tails up off the ground without expending any more muscular energy,” says Reisdorf. Underwater, however, the effect of gravity is significantly reduced. This allows the ligament to contract fully, causing the neck and head to arch backwards at once.

Achim G. Reisdorf is a doctoral researcher in sedimentology (Jurassic stratigraphy and paleogeography of northern Switzerland) at the Department of Biogeochemistry and Global Material Cycles / Earth Sciences at the University of Basel. Born in 1967 in Freiberg, Saxony, he trained as a skilled worker in geology before qualifying as a geological engineer from Freiberg University of Mining and Technology. He went on to study geology and paleontology at the University of Tübingen, where he completed his ‘Diplom’ in 1998. Reisdorf is also active as a festival organizer and CD producer on the new music scene.



‘Kitchen science’ with chicken necks: Geoscientist Achim Reisdorf with the dinosaur model at Basel Bruderholz (Image: Andreas Zimmermann).

### A good dose of humor

The publication of these findings in the journal *Palaeobiodiversity and Palaeoenvironments* in February caused an international sensation. There was huge media interest, with numerous reports appearing on television, on the radio and in the press; the story even made the *New York Times*. “I never imagined it would have such an impact,” Reisdorf observes. He and Wuttke also presented the chicken neck experiment at the Basel Science Slam, which was “a huge amount of fun”. “Mind you, my performance was still a bit stiff and clumsy,” the 45-year-old admits. That did not stop him being invited to take part in science slams in Zurich and Freiburg shortly afterwards, where he was able to improve his performance, placing second and then even winning first place. “There was a real buzz in the audience, which was amazing.” Requests for further appearances are now flooding in. So, is Reisdorf eyeing up a career as a science performer? He dismisses this suggestion. “Not at all, but I think it’s important and exciting to bring science closer to the public in different ways, and sometimes that is best done with a wink and good dose of humor.”

Reisdorf, who was raised in the German Ore Mountains, first became interested in decoding fossil finds when he moved to Basel 13 years ago, and, rather incidentally, came across his first ‘crime’. He discovered the ‘corpus delicti’, the fossil skull of a dolphin-like ichthyosaur, by chance, while examining rock strata in a clay pit on the Unterer Hauenstein pass. Reisdorf is actually a sedimentologist who is writing his doctoral thesis on early Jurassic deposits in northern Switzerland. At the dig, he hit an extremely hard layer of rock that he had to break through. “The limestone was so hard that I ruined a chisel hammering away at it. Suddenly the ‘fossil eye’ of an ichthyosaur was staring up at me. The rest of the skull was still embedded in the rock.” It turned out that the skull belonged to an ichthyosaur whose rib cage had been discovered in the same clay pit six months earlier by Christian Meyer, the current director of the Museum of Natural History in Basel.

### The upside-down ichthyosaur

The bizarre thing about the find was that the ichthyosaur’s remains were aligned vertically rather than parallel to the layers of sediment, as is normally the case with vertebrate fossils. “That was when it gripped me – I wanted to find out how this animal could have ended up headfirst in the rock.” There is a hypothesis, which can still be found floating around in the academic literature, that the gases generated in corpses after death cause them to explode. In this scenario, the Hauenstein ichthyosaur would have been catapulted into the sediment like a missile. Reisdorf, who regarded that as unlikely, was employing unconventional methods even then. As well as trawling through the literature and consulting paleontologists, he contacted specialists in veterinary and forensic medicine. “The experts explained to me that corpses of vertebrates can’t explode.”

With the instincts of a detective, he finally hit on a plausible explanation. If ichthyosaurs sank to the sea floor after their deaths, they must have had a higher relative density than sea water. As they sank, the water pressure rose, compressing their flexible rib cage and, with it, their lungs. In this particular species, that shifted the ichthyosaur’s center of gravity forwards, causing it to topple headfirst into the seabed, which was very soft. The ‘kamikaze ichthyosaur’, as Reisdorf blackly dubs it, was then encased in a carbonate concretion. He and his supervisor Andreas Wetzel were able to show that gradually this concretion and its accompanying fossil were driven down like a wedge into deeper and, therefore, significantly older rock strata by the weight of later deposits.

So far, Reisdorf has also been able to shed light on some other mysterious fossil finds. This year his unconventional, creative methods and interdisciplinary approach when hunting for evidence are even likely to earn him a nomination for the alternative Nobel Prize. “It’s not definite yet,” he points out modestly. Either way, when talking about ‘his’ fossils, he has a real ability to engage the listener, bringing alive these rather dusty stones from millions of years ago. “The thing that never ceases to fascinate me is that fossils were once living creatures. Millions of years ago, they populated our planet as plants and animals, breathing, flowering and giving off scents.” It is obvious why it has taken him a bit longer than expected to complete his studies in his actual research area, sedimentology, but he certainly cannot be accused of taking it easy. Working patiently and with extreme precision, he has spent weeks and months clambering around clay pits to develop a new, standardized classification, based on international standards, of early Jurassic deposits in northern Switzerland. This new stratigraphic scheme was published in 2011.

Katharina Truninger is a professional freelance journalist in Basel.

# Greater insights into pain

Life-supporting care means that preterm babies may experience pain frequently on a daily basis, which has significant consequences in their later lives. Equally, many cancer outpatients have pain that is not adequately managed. Two current research projects at the Institute of Nursing Science are looking at optimizing pain management in preterm infants and patients with cancer. The results are likely to find their way into clinical practice. Eva Cignacco/Gila Sellam and Antje Koller

The incidence of preterm births (i.e. births before 37 weeks of pregnancy) has risen over the past few decades. In Switzerland, the current rate of preterm births is approximately 7%. Some of the causes of this trend are a higher average maternal age and the use of new reproductive technologies associated with a risk of premature birth. Improved standards of treatment have made it possible for extremely preterm infants to survive, but have not eliminated the need for intensive care. Over the many weeks that these infants are in hospital, they undergo an average of 14 painful diagnostic and therapeutic interventions per day. Repeated exposure to pain can cause permanent changes in the cellular structure of the brains of preterm infants, hindering their motor and cognitive development and altering their sensitivity to pain.

Most painkillers are not tested on preterm infants and are not used to treat them due to the high risk of serious side effects. As a result, the pain of these patient groups mostly goes untreated. However, there are a variety of non-pharmaceutical interventions available to relieve mild to moderate pain. Extensive research has been carried out on a number of approaches, including oral administration of a sucrose solution, holding the infant in the fetal position (known as ‘facilitated tucking’), kangaroo care and breastfeeding. These techniques regulate physiological and behavioral responses, shift the child’s attention away from the pain and modify the actual pain impulse. Dr. Gila Sellam’s doctoral research investigated the separate and combined effects of oral sucrose and facilitated tucking. This involved gauging the pain responses of 71 babies born prior to, or during, the 32<sup>nd</sup> week of gestation when repeated heel sticks were carried out. The

results show that oral sucrose is effective in reducing pain, both on its own and in combination with facilitated tucking.

Dr. Antje Koller’s thesis, which was also completed at the Institute of Nursing Science, provides new information about how nursing staff can help patients with cancer and their family caregivers to manage pain in daily life. More than 40 percent of patients with cancer receive inadequate pain management. Challenges are encountered at various levels; for instance, some patients are afraid of becoming addicted to painkillers. Dr. Koller based her research on a US-developed pain self-management intervention (ProSelf © Plus PCP) for cancer pain patients and family caregivers. Her aim was twofold: firstly, to find out whether the program – which she adapted and translated into German – could be carried out with German-speaking patients, and, secondly, to pilot test its effectiveness.

Patients’ understanding of pain management increased considerably, even though only a modest amount of pain relief was achieved. The program proved to be feasible, however, a need for a modification of recruiting methods and the incorporation of counseling on symptoms such as nausea became apparent. The program’s emphasis on the daily lives of patients and their trust in nursing staff resulted in a high degree of satisfaction, although patient attitudes to the use of painkillers remained ambivalent. Providing a basis for optimizing the intervention and for planning a follow-up study, the research projects will help to further improve our understanding of pain management in cancer patients.

Dr. Eva Cignacco is a research associate and principal investigator on the study of preterm babies conducted by Dr. Gila Sellam. Dr. Antje Koller is a research associate at the Institute of Nursing Science, University of Basel.

# Microfilm archive: preservation and discovery

The microfilm archive at the Department of Musicology has been in existence for 75 years and is the only one of its kind in Europe. With over a million microfilm images, including a wealth of unpublished and destroyed sources, it is one of the largest collections in the German-speaking world. Ramona Hocker



Tiny black, fragile characters on transparent celluloid, entire codices disintegrated and compressed onto a few meters of film: the complete history of music in a row of steel cabinets. Here you can find Bach alongside an Arabic treatise, a barely legible medieval courtly love song next to organ music, and music from the Council of Basel sitting beside operas from the Imperial Court in Vienna. These cabinets represent the meeting of cultures; they preserve artifacts that have decomposed, vanished into private collections or have been destroyed. Look through the countless windows and catch a glimpse of another world, revisit the moment when these manuscripts were written. Under the glare of the projector, however, the film material comes to life and we are reminded of a different history, the history of the archive.

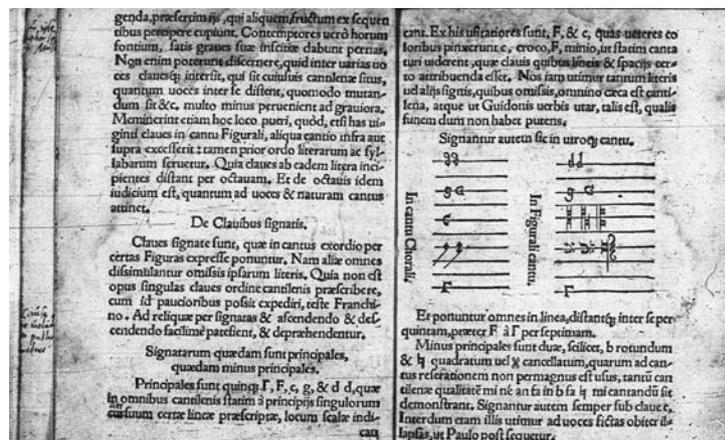
The microfilm archive at the Department of Musicology was founded 75 years ago. In 1936, the director at the time, Jacques Handschin, submitted an application to the Voluntary Academic Society of Basel (FAG) for 600 Swiss Francs to purchase photographic equipment. The aim was to create photographs of manuscripts, which would then allow scholars to study the 'originals' that had been passed down. By the start of 1937, the Department had bought instruments and equipment including films, albums, and film envelopes, and was ready for operation. The first Swiss manuscripts were



microfilmed soon thereafter, along with other sources on loan to Basel. The rapid expansion is reflected in the annual financial receipts for the Department: in the first few years, 40% of its total budget was spent on the archive. Records of orders show that by the second year of the archive's existence, the geographical area to be covered was extended and sources were ordered from the "unique collection that is as yet under-researched by music scholars" at the Bibliothèque Nationale in Paris. The establishment of the Basel archive played a significant role in encouraging scholarship, particularly the research of little known sources from the medieval and early modern periods. Even today, the comprehensive pool of over 10,000 films (or over one million individual photographs) remains unparalleled in Europe in terms of scope and its systematic approach to collecting: it contains almost every known source of pre 16<sup>th</sup> century monophonic and poly-



Manuscripts and prints from the collection (from left): Joseph Haydn, Canon cancrizans, Ludwig van Beethoven, aria 'Dimmi ben, mio' and sketch; Henry Faber, Ad musicam practicam introductio (Images: Microfilm archive, Department of Musicology, University of Basel).

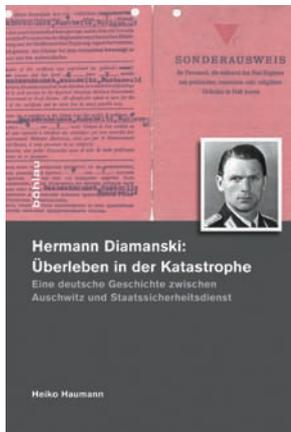


phonic music, a broad selection of medieval music theory manuscripts from European and Arab cultures, as well as a selection of representative collections from the 16<sup>th</sup> to the 20<sup>th</sup> centuries.

The annual reports from the years during World War II illustrate the extent to which films of almost completely disintegrated manuscripts themselves bear witness to history: while it was increasingly difficult to acquire new sources since many of the manuscripts were moved away, the Basel films then “replaced the originals which were no longer available for use by external researchers” – which is still true today in some cases. The historical value of the photographs is clear, especially those from the early years of the archive which are the only documents that facilitate research on sources that were destroyed during the war.

Ramona Hocker M.A. is a lecturer in Musicology at the University of Basel, and Director of the microfilm archive.

<http://mwi.unibas.ch/mikrofilmarchiv>

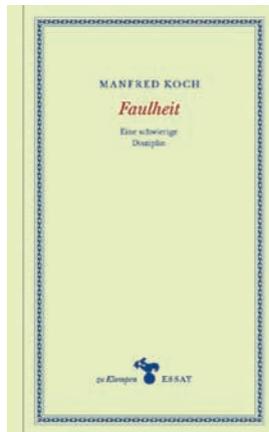


### A German life

The life of Hermann Diamanski (1910–1976) encapsulates the history of Germany in the 20<sup>th</sup> century. The book takes as its focus not a ‘great personality’ but a ‘simple man’. Diamanski, a sailor and a Communist, was active in the underground opposition to National Socialism and fought in the Spanish Civil War. He was a camp elder in the ‘gypsy camp’ at Auschwitz and was forced to take part in the death march to Buchenwald in January 1945. After the war, he made a career for himself in East Germany, but he soon came into conflict with the GDR authorities, attracting the attention of the Stasi. He fled to West Germany, where he worked briefly for the US secret service. Although he testified as a witness at the Auschwitz trial, it was many years before he received compensation as a victim of the Nazi regime.

The book sheds light on some key moments in history, illustrating the extent to which private lives and political events can become intertwined. It aids our understanding of how memory is constructed, the impact of traumatic experiences, the tension between individual and collective memory, and why gaps in memory can themselves be revealing. Professor Heiko Haumann, Emeritus Professor of Eastern European and Modern History at the University of Basel, first came across Diamanski by chance. After years of exhaustive research, he has produced a fascinating and detailed biography – running to more than 400 pages – that treats its subject with respect and empathy.

Heiko Haumann, Hermann Diamanski: *Überleben in der Katastrophe. Eine deutsche Geschichte zwischen Auschwitz und Staatssicherheitsdienst (1910–1976)*. 443 pp., 56 b. and w. illus. Geb. Böhlau Verlag, Cologne 2011. EUR 39.90, ca. CHF 56.90.

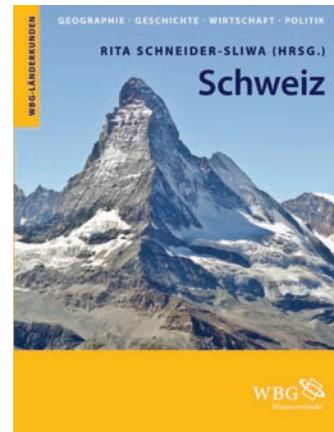


### The joys of idleness

Nearly all origin myths portray man as a cultural being. Even in paradise he is said to have worked, albeit in harmony with his nature. Back then, people had no sense of the distinction between toil and leisure. Later the sweet dream of idleness was born. Today, societies see full employment as the ultimate prize, and frantic busyness is the order of the day even outside work, with people who choose to take it easy at the weekend feeling required to justify their behavior. In classical times, however, leisure was considered the ideal. Even during the Middle Ages, society took an indulgent view of the idle and unmotivated. The change came only in modern times, when belief in progress and the desire for improvement robbed the layabout of his innocence, turning him into a parasitic creature.

For some time, the idea that we need to slow down has been gaining support. People cannot help feeling a sneaking sympathy not just for fictional idlers such as Oblomov, the eponymous hero of a novel by Ivan Goncharov (1812–1891), but also for those who opt out of the hustle and bustle of society at large. However, the vast array of recreational opportunities and digital distractions on offer today mean that it has rarely been so difficult to be lazy. In the five essays in this volume, the author presents an entertaining and concise cultural history of leisure over more than two millennia, initiating his readers into the delicate art of laziness. Professor Manfred Koch is an associate professor (‘Titularprofessor’) of Modern German Literature and General and Comparative Literature at the University of Basel.

Manfred Koch, *Faulheit. Eine schwierige Disziplin. Essays. Zu Klampen Verlag, Springe 2012*. Hardback, 158 pp., CHF 28.40.



### At the heart of Europe

This richly illustrated volume is the most comprehensive survey to date of the geography, economy, history and politics of Switzerland. The team of around 30 contributors takes a strongly interdisciplinary approach, exploring not just the physical environment, history and political system of Switzerland but also issues of cultural diversity and the country’s complex linguistic landscape. The book provides a clear analysis of the developmental processes that are shaping Switzerland today: the move to a service-based economy, structural changes in the rural sector and the Alps, settlement development, changes in the cultural landscape, urban development and new approaches to spatial planning, strategies for dealing with climate change and natural hazards, and the importance and impact of tourism. Other issues discussed include migration, social developments in the cities, levels of wealth and poverty, and policy approaches to development at urban, metropolitan and regional level. Finally, Switzerland is placed within a broader frame of reference through an examination of its political and economic position in Europe and the world.

The editor, Professor Dr Rita Schneider-Sliwa, is a professor at the University of Basel, where she heads the Center for Human Geography and Urban and Regional Research in the Department of Environmental Sciences.

Rita Schneider-Sliwa (ed.), *Schweiz. Geographie, Geschichte, Wirtschaft, Politik*. In the series ‘WBG-Länderkunden’. 240 pp. with numerous color illustrations and diagrams. WBG (Wissenschaftliche Buchgesellschaft), Darmstadt 2011. CHF 69, EUR 29.90.

# Eva Maria Spehn



Dr. Eva Maria Spehn is a research associate at the Institute of Ecology and Plant Systems/Botany, University of Basel. She completed her doctorate in Basel as part of a European research project on biodiversity and ecosystem functions, and since 2000 she has been coordinating the Research Network 'Global Mountain Biodiversity Assessment (GMBA)' from DIVERSITAS, the international network for biodiversity research. In addition, she has been working as a research associate for the Biodiversity Forum at the Swiss Academy of Sciences in Bern since 2012, where her role is to develop and manage the Swiss interface of the new 'Intergovernmental Platform on Biodiversity and Ecosystem services'. Her research areas include the effects of biodiversity on ecosystem functions as well as the impacts of changes in climate and land use on biodiversity. The GMBA network is currently working with large biodiversity databases containing regionally collected data that will form the basis of new data portals. Researcher and even any interested members of the public can learn about animal and plant discoveries, and are encouraged to submit their own entries in order to create and constantly improve a future-oriented knowledge base for biodiversity. Eva Spehn is married and has two children.

## Encyclopedia of Life

[www.eol.org](http://www.eol.org)

Information about the life forms on Earth that are known to science: animals, plants, fungi, protists and bacteria.

## Biodiversity data

<http://data.gbif.org>

Search portal with 300 million data records of different species, mostly from museum collections but also from field observations – from beetles to birds, plants and fungi. The GMBA Mountain Portal ([www.mountainbiodiversity.org](http://www.mountainbiodiversity.org)) allows you to search this data according to mountain regions, and to select specific habitats, e.g. alpine regions. For amateur ornithologists and plant enthusiasts: you can enter your own observations and share them with others at [www.infoflora.ch](http://www.infoflora.ch) and [www.ebird.org](http://www.ebird.org).

## Biodiversity in Switzerland

[www.biodiversity.ch](http://www.biodiversity.ch)

Publications, news and activities from the Biodiversity Forum, a center of competence for biodiversity research in Switzerland.

## Dot Earth

[dotearth.blogs.nytimes.com](http://dotearth.blogs.nytimes.com)

My favorite blog on environmental issues, written by Andrew C. Revkin in *The New York Times*. The newest ideas 'from suburbia to Siberia' are investigated, for example, the ways in which we attempt to reconcile our needs as humans with the limitations of the planet.

## Environmental research in developing countries

[www.scidev.net](http://www.scidev.net)

An online magazine that explores ideas on how to reduce poverty, improve health and raise standards of living around the world. Most articles are written by experts based around the world and represent a reliable source of information about science and technology in the respective countries.

## Nature conservation areas around the world

[www.protectedplanet.net](http://www.protectedplanet.net)

Here you can view all the nature conservation areas in the world on an interactive map: it includes information and pictures of (almost) every one of these, as well as lists of the endangered and non-endangered species that inhabit the area.

## Word clouds

[www.tagcrowd.com](http://www.tagcrowd.com)

This website allows you to create beautiful word clouds, whereby the words that occur most frequently in a text are depicted larger than the others: it is ideal for visualizing texts or web contents.

## Ideas in 18 minutes

[www.ted.com/talks](http://www.ted.com/talks)

A collection of highly entertaining and exciting presentations given at TED (Technology, Entertainment, Design) conferences. Exceptional people are invited to the conference to explain their ideas to the world in a maximum of 18 minutes – and give the presentation of their lives ...

## UNI NOVA 119 (March 2012): Focus on 'Africa' Multifaceted research

It is interesting to discover what a broad range of research on Africa is being carried out in Basel. I also enjoyed the posters – to see how the design, in parts, reflects the era of the Cold War with a visual language that was seen in quite different areas of the world.

I would have also appreciated an article by Professor Max Bergman whose research looks at the South African school system, among other things. This would have rounded off the magazine very nicely.

*Martha Vogel, Lucerne (Switzerland)*

## UNI NOVA in general

### Pleasure

I subscribe to the UNI NOVA magazine and am always delighted to receive it. The articles cover a broad range of topics and provide great detail, and yet are still very accessible. It's a pleasure to read.

*Reida Rutte, Oxford (UK)*

## Corrections

### UNI NOVA 119 (March 2012): Focus on 'Africa'

In the article, 'Corruption from the Mediterranean to the Cape' (pp. 18–19) Silvio Berlusconi was described wrongly as the former Italian 'State President' – the correct term is 'Prime Minister'.

**Gender Studies****Fall Semester 2012**

**Series of interdisciplinary lectures providing an introduction to gender studies, organized by the Center for Gender Studies.**

Tuesdays, 2.15pm–4pm, held in lecture hall 116 of the University Kollegienhaus, Petersplatz 1, Basel.

**Imaging****October 1**

**Functional imaging in Psychiatry – possibilities for application?**

Lecture given by Professor Jürgen Gallinat from the Charité Berlin, 5pm–6pm, School of Psychiatry (UPK Basel), 1st floor, lecture hall, Wilhelm-Klein-Strasse 27, Basel.

**Mahler Reception****October 4, 18 and 22;****November 15 and 25**

**Contemporary interpretations of Mahler**

Lecture series on the current reception of Mahler. Organized by the Department of Musicology (Musikwissenschaftliches Seminar) and held at the Department of Musicology and Basel city casino (Stadt-Casino Basel). Further information: mahler.unibas.ch

**Financial Penalties****October 16**

**On financial penalties**

Public inaugural lecture given by Professor Axel Paul, Professor of Sociology, at 6.15pm, Museum auditorium (Aula der Museen), Augustinergasse 2, Basel.

**100 Years of Archeology****October 19**

**Celebrating the centenary of Archeology at the University of Basel and the opening of the accompanying exhibition 'Bones, fragments and sculptures' ('Knochen, Scherben und Skulpturen')**

until December 19, 2012, Rosshof, Petersgasse 51, Basel.

**MINT Competencies****October 23–24**

**Conference on developing competencies in MINT subjects (Mathematics, Information technology, Natural sciences, Technology) to strengthen Switzerland as a center of education, industry and science as part of the Worlddidac Basel/Didacta Switzerland education fair**

at the congress center, Messe Basel.

**First World War****November 14**

**Outbreak of the First World War**

Evening event held at Basel University Library with Irene Amstutz (lic. phil.), Esther Baur (lic. phil.), Dr. Franz Egger and Dr. David Tréfás from 6pm–7.15pm (approx.), University Library, meet at the lecture hall, 1st floor, Schönbeinstrasse 18–20, Basel (Free entry; registration required: 061 267 31 00 or info-ub@unibas.ch). Future evening events: www.ub.unibas.ch

**Family****November 15**

**Family since the Middle Ages: the development of a concept of relationships**

Evening lecture given by Professor Simon Teuschler as part of the workshop for early career researchers in Family Sciences. Organized by the Center for Family Sciences and held at the Faculty of Law, Peter-Merian-Weg 8, Basel, from 5.30pm–8pm. Further information: www.famwiss.ch

**100 Years of the Basel Peace Congress November 22–24**

**Academic conference on the centenary of the 1912 International Socialist Peace Congress 'Against War' in Basel and on the concept of peace today. Organized by the University of Basel's Department of History and held at the University**

Kollegienhaus, Petersplatz 1, Basel. Further information: <http://basel1912-2012.ch>

**Financial System****November 26**

**The real economy and the financial system: are we facing a sea-change?**

Talk given by Dr. Konrad Hummler, St. Gallen. Organized by the Basel Society for Economics and Statistics ('Statistisch-Volkswirtschaftliche Gesellschaft Basel') at 6.15pm in the auditorium of the Kollegienhaus, Petersplatz 1, Basel.

Information on future events:

[www.svgbasel.ch](http://www.svgbasel.ch)

**Depression****November 29****Depression**

Lecture given by Professor Undine Lang as part of the series of Thursday Conferences ('Donnerstagskonferenzen') for specialists in internal medicine, from 11.15am to 12.15pm at the Center for Teaching and Research, small lecture hall, Hebelstrasse 20, Basel.

**Sleep and Neurology****December 20**

**Sleep and Neurology: clinical and scientific significance**

Lecture given by Professor Claudio Bassetti, Consultant Neurologist, Department of Neurology, Bern University Hospital, at the Center for Teaching and Research, small lecture hall, Hebelstrasse 20, Basel, from 2.15pm–3pm.

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**Informations-Abend** Mittwoch, 24. Oktober 2012

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