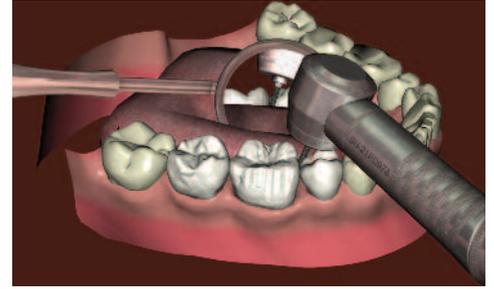




THE STUDENTS in Dr. Margrit Maggio's Operative Dentistry class have seen the future, and it's called haptic technology.

Interfacing with users through their sense of touch, haptic technology is the force behind the Simodont advanced simulation units that Dr. Maggio (D'87), Assistant Professor of Clinical Restorative Dentistry and Director of Operative Dentistry and the Advanced Simulation Laboratory, introduced to her first-year students last fall as part of a year-long study comparing haptic technology to traditional advanced simulation systems. Her research results will be published later this year.

Through this year-long pilot, which used two Simodont units, every first-year student was trained on these cutting-edge



clinical situation and varying conditions much more realistically, while objectively assessing and supporting the individual capabilities and needs of each student," he says. "These virtual reality tools are extremely beneficial in preparing our students for our ultimate goal: highest-quality patient care."

FEELING THE DIFFERENCE

Ask anyone who has tried both traditional advanced-simulation technology, which uses replaceable plastic teeth that fit into plastic model heads, and the advanced haptic simulation experience provided by a Simodont unit, to compare the two, and the answer will most likely be that the difference is in the feel. Manufactured by The Netherlands-based Moog, which for years has created highly realistic flight simulators for pilots and astronauts in training, haptic technology allows the user to "feel" the difference between different layers of a tooth. "Plastic feels like plastic. But with the Simodont, enamel feels like enamel, dentin feels like dentin, pulp feels like pulp, and a root feels like a root," explains Dr. Maggio.

The result is a much more realistic training experience that allows students to see (using 3-D glasses for depth perception) and work on a virtual tooth, with different colors representing its layers (dentin is yellow and pulp is red, for example), and to "feel" what makes each layer unique using virtual dental instruments. Most users begin their training by practicing cutting out different shapes with the virtual drill, choosing a level of difficulty, and selecting the proper bur.

HAPTIC TECHNOLOGY

AT THE FOREFRONT OF VIRTUAL REALITY

Penn Dental Medicine is moving its instruction forward with a cutting-edge, advanced-simulation training experience that looks and feels like the real thing.

OPPOSITE: With the simulated handpiece (in the right hand) and the simulated mirror (in the left), students feel the tooth preparation in virtual reality and see the tooth preparation and instruments (above) through the Simodont screen.

dental training units, which deliver an incredibly realistic virtual reality simulation of dental procedures.

Although Simodont units are being used at schools in Europe and Asia, Penn Dental Medicine is the first dental school in North or South America to integrate the technology into its curriculum. As the number of units increases, says Dr. Maggio, Penn Dental Medicine will become "a showcase for other schools" across the country.

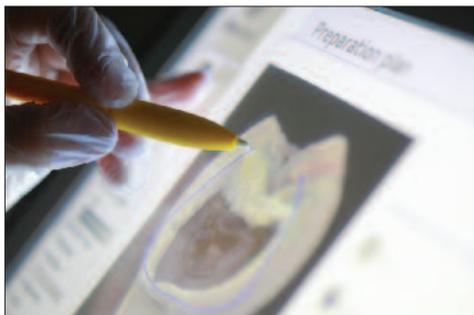
"Penn Dental Medicine has been at the forefront of virtual reality in preclinical training for the past 13 years," she says. "With the use of the Simodont, we are moving into a new phase: we're matching virtual reality with sensitivity to touch."

Dr. Markus Blatz, Chair and Professor of Restorative Dentistry, is excited about the many ways in which this advanced-simulation technology will benefit Penn Dental Medicine students. "Through the sheer endless possibilities of these units, we can simulate the

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When they have mastered the various levels of drilling skills, they graduate to working on a virtual tooth, which they select through a virtual case study, complete with patient photo, background, patient history, and treatment plan. They are tasked with selecting the proper virtual tools to drill or scoop out decayed tooth sections and fill the cavity. In addition, says Dr. Maggio, “By pressing a button, students can see a filling in the tooth that’s been overfilled, and, by choosing the correct hand piece or hand instrument, they can refine the filling back to the anatomy of the tooth.”

In addition, “The Simodont simulation requires students to learn to use the mirror at an earlier stage” than they would otherwise, says Dr. Maggio, and in a more accurate way. With traditional simulations, she explains, it is possible to “cheat” when learning indirect vision procedures on the maxillary arch by repositioning the model or the student’s own body in ways that would not be possible in real life, but with a Simodont, students are required to learn to hold and use the mirror the correct way, and to use it properly each time. She also admires the way that a Simodont unit can adapt, at the click of a button, to a right- or left-handed student. “With our old units, we had a separate unit for left-handed students that sat idle otherwise,” she says. “That’s not necessary now.”



ABOVE: Students identify the carious lesion and draw the outline for the preparation on the unit’s interactive case presentation screen.

TOP: Dr. Margit Maggio, describing the use of the Simodont.

OPPOSITE: First-year students Brittany Gragg (D’17) and Harold Robinson, III (D’17), working on tooth preparations on the Simodont units.



All of these capabilities mark the advent of a new era in virtual reality teaching, she says: “The Simodont is particularly effective in developing psychomotor skills through the ease of repeating a lesson. And through the way the lessons are structured, it teaches students to think and practice at the same time.”

A COLLABORATIVE AGREEMENT

Dr. Maggio, who counts advanced simulation among her ongoing research interests, has been following the development of the Simodont with great interest over the past several years. She has been in regular contact with Moog, its manufacturer, to check on its progress, waiting for the right moment to introduce the new technology to her students. Through an agreement with Moog, she will be continuing to work with the company to establish requirements for new software for the North American market, evaluate the educational benefits of adding Simodont to the curriculum, and developing a cost-of-ownership model to help other schools understand the costs versus benefits of the new technology. In addition, Dr. Maggio has agreed to work closely with Moog to explore the development of new curriculum for the units, noting the potential for applications like suturing, periodontic scaling, and lessons in endodontics: “There are so many possibilities!”

Penn Dental Medicine’s fully outfitted advanced simulation lab will feature 12 units—ten new units as well as updates to its two existing units. At press time, it was anticipated that all 12 units would be in place by this year’s Alumni Weekend, May 16-18, so

that graduates of all ages will have the impressive and eye-opening experience of trying haptic technology—and comparing the state-of-the-art simulation to the reality of practice.

REALISTIC, COST-EFFECTIVE, AND WELL DESIGNED

While this year’s class of first-year students have had a relatively short introduction to this advanced simulation, Dr. Maggio plans to begin next year’s Operative Dentistry class with complete immersion in the technology, using a summer session offered to college students considering the field of dental medicine as a chance to refine the classroom experience. Gradually, she may also bring second-year students into the lab to use the Simodont units to train for more complicated procedures, such as crowns.

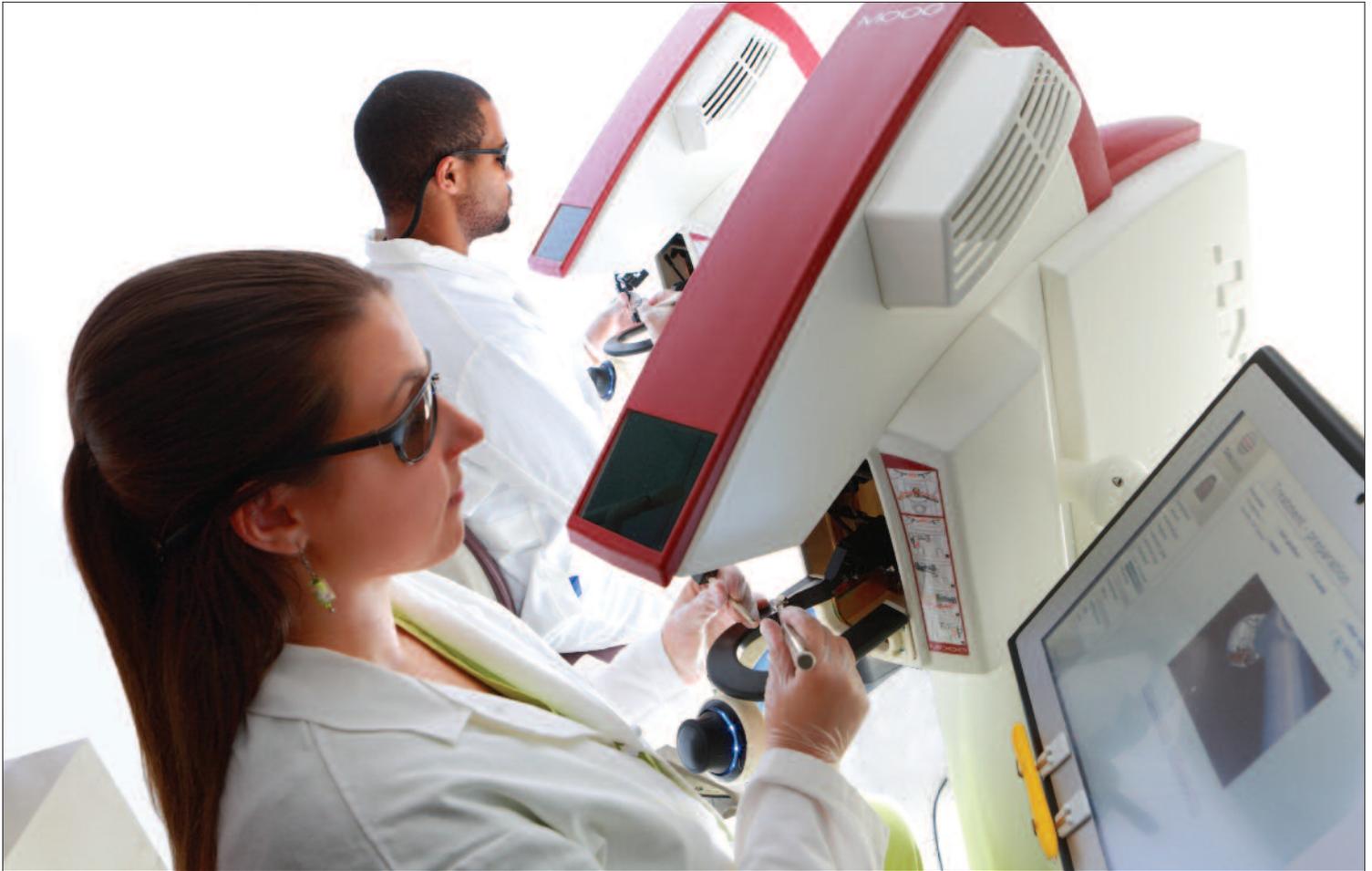
Despite their limited time on the Simodont units, members of the inaugural class formed immediate impressions of the technology. “You can tell the difference between enamel and dentin,” says John Shue, (D ’16). “That’s not something we were ever able to do before.”

The beauty of the Simodont unit, he adds, is that unlike the old technology using replaceable plastic teeth, the virtual digital teeth cannot be destroyed. In fact, a new tooth is only a click away.

“There’s a reset button,” says Shue, “so there’s a lot less stress about messing up.” With this newfound freedom, he says, “you can press the boundaries rather than having to be conservative,” leading to stronger skills overall.

Poolak Bhatt, (D ’16), agrees. “Being able to reset saves time, and we don’t have to worry about wasting materials.” Although he watched a YouTube video on the Simodont before he tried it, he was still unprepared for the intensity of the experience. “It was a lot more realistic than I expected,” he says.

“You can actually feel two [virtual] instruments clicking together,” and it feels just like two metal instruments would actually feel, he adds.



The Simodont is not only highly realistic, cost-effective, and convenient, it's also well designed and fun to use, says Taylor Hagler, (D '16), an avid video gamer. "The screen is very cool," he explains. "The controls are intuitive and they make sense."

Dr. Maggio looks forward to a day in the near future, when, with all the Simodont units in place, students can receive additional practice at night or during their free time, simply by coming to the lab and swiping a card. "Our old technology was too fragile for me to allow students to use it unsupervised," she says, but the new units will provide students with as much practice as they need, at no additional cost, in and out of class.

SHAPING THE FUTURE

The new Simodont technology is among the first steps in plans for a major transformation of facilities within the historic Evans Building. This renaissance of this landmark structure will not only include a new space for the Simodont advanced simulation lab, but will also create a new Preclinical Lab and CE Training Center, a new primary care clinic, a new library, and new student spaces and administrative offices. The result will be a state-of-the-art, technologically advanced dental learning environment that will rival any nationwide.

"A Simodont will never replace an instructor," says Dr. Maggio, whose Simodont teaching screen will allow her to monitor the simulation work of all 12 student users simultaneously, "but it can help students to

practice the same skill over and over" until it's perfect. Haptic technology is cost-effective and convenient, but most importantly, it greatly increases opportunities for more realistic practice, which she believes will ultimately result in improved skills and better patient care. ■

—By Juliana Delany