Tooth-wear gauge opens up dental research

With the aid of powerful scanning electron microscopes, an anatomist has developed the first method for directly measuring daily or weekly rates of tooth wear. The technique's developer, Mark F. Teaford of the Johns Hopkins University in Baltimore, says it represents "a real breakthrough" that will stimulate a wide range of dental research in areas such as age-related changes in tooth use, the effects of orthodontia and other dental procedures, and tooth wear linked to diets of different groups of animals.

Teaford's technique "is a major advance," says anthropologist and dental researcher Lawrence B. Martin of the State University of New York at Stony Brook. "It can yield natural rates of tooth wear, which we know little about, and has broad applications for the analysis of the feeding ecology of all mammals."

Most dental clinicians and researchers ignore human tooth wear because it occurs so slowly, Teaford says. Annual enamel loss on molars rarely exceeds 50 microns in most human groups, largely because modern foods contain few abrasive materials.

Nevertheless, changes in the number of microscopic marks dug into human tooth enamel while chewing reveal weekly rates of wear at specific locations on teeth, report Teaford and Carolyn A. Tylenda of the FDA, who will present their findings in the JOURNAL OF DENTAL RESEARCH.

In the Hopkins study, nine healthy adults had two sets of epoxy casts made from putty impressions of their lower first and second molars, with the second set made no more than seven days after the first. Each volunteer recorded all food consumed between the two sessions.

The researchers placed the epoxy casts under a scanning electron microscope and took pictures of minute scratches and pits etched into teeth during the study period. Some images focused on the chewing surface nearer the cheek, used in shearing and crushing; others highlighted the grinding area nearer the tongue. A count of marks from each tooth region on both sets of casts revealed the proportion of new microscopic "wear features" for each volunteer.

A study of captive monkeys directed by Teaford two years ago found the proportion of wear features created in one week correlates closely with annual enamel wear on a molar's chewing surface. The researchers used this finding to calculate yearly rates of tooth wear for the humans.

Not surprisingly, human tooth parts exclusively involved in crushing and grinding showed much faster wear than those used for cutting and shearing. The one volunteer with greater wear on shearing areas was also the only one who ate mainly salads and fresh vegetables during the study. Other participants ate pizza, hamburgers and similar fare.

The ability to record daily or weekly tooth wear has many applications, Teaford says. For example, orthodontists could monitor how tooth use changes as a result of their procedures, rather than relying on indirect measures, such as impressions of bite patterns. Moreover, the technique may provide a measure of tooth grinding and help clinicians assess the utility of mouthguards worn by people who grind their teeth.

In a separate study scheduled for publication in the AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY, Teaford and Kenneth E. Glander of Duke University in Durham, N.C., calculated weekly rates of tooth wear for nine wild monkeys in Costa Rica. The researchers trapped each monkey, anesthetized it and took tooth impressions, repeating the procedure with the same monkeys three to nine days later. Back in the laboratory, they made epoxy casts of molar teeth.

Teaford and Glander found that the monkeys, which live in a dry tropical forest, wear down their molars much faster than the human volunteers and at nearly the rate of previously studied laboratory monkeys raised on a diet of abrasive monkey chow. Unlike humans and laboratory monkeys, the wild monkeys wear down shearing regions of their molars faster than areas devoted to crushing and grinding, probably because mature leaves make up much of their diet.

Further work must establish whether the observed rates of tooth wear prove typical for humans and monkeys. "But this is the first direct evidence of differences in molar use between primates with different diets," Teaford says. "We can now document how teeth are used in virtually any setting."

Continuing use of the new technique promises to provide better comparative data with which to evaluate wear marks on the fossil teeth of human ancestors, Martin says. To obtain such data, researchers currently compare the marks on these fossils with those on primate teeth in museum collections. *– B. Bower*

Fetal repair: Safe for mom, chancy for child

A bold new surgical approach to repair fetal defects in the womb poses no undue hazard for mothers, say researchers who have performed the operation since 1981. However, the experimental procedure remains a risky gambit for the tiny fetus.

Michael R. Harrison, a pediatric surgeon at the University of California, San Francisco, pioneered the technique to correct several fetal flaws, including diaphragmatic hernia. This defect – resulting from a hole in the muscular wall, or diaphragm, separating the chest cavity from the abdomen – allows the fetal intestines to protrude into the chest, where they prevent normal lung development. Although surgeons can sew the diaphragm together after birth, the underdeveloped lungs cause breathing difficulties that often kill the newborn.

To give these babies a better shot at survival, Harrison operates before birth, usually during the second trimester. With the mother under general anesthesia (which reaches the fetus as well), he cuts through the mother's abdominal wall, lifts the arm of the fetus and makes an incision in the fetus' chest. He then tucks the fetal intestines back into the abdomen and sews a patch over the diaphragm hole, creating space for the lungs to develop normally.

However, the invasive procedure threatens the fetus with a risk of premature labor, since it can trigger uterine contractions even when mothers take drugs to prevent that complication. Babies born too soon risk death due to underdeveloped organs.

While Harrison and his co-workers have yet to solve that problem, they have now demonstrated that – at least in their hands – the procedure does not jeopardize the life of the mother. In the Feb. 13 JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, they report no maternal deaths or serious maternal injuries in their first 17 fetal operations, performed between 1981 and 1989. All cases involved severe fetal defects, which, if left untreated, were likely to kill the infants soon after birth.

The procedure, while offering hope for fetal survival, remains tricky. In three cases, the team couldn't repair the fetal defect and performed abortions in accordance with the mothers' prior requests. While the remaining 14 operations went smoothly, all of these mothers went on to deliver prematurely. The 14 fetuses made it through the operation, but only "some" survived beyond the preterm delivery, Harrison told SCIENCE NEWS. He declined to specify the number of survivors but acknowledged that the rate needs improvement.

Among the mothers, the operation had "no detectable effect on future fertility," the team reports. Eight women subsequently experienced normal pregnancies; the researchers say they couldn't assess the fertility of the others.

Whether the surgery effectively treats fetal flaws remains an unanswered question, notes Howard C. Filston, a pediatric surgeon at the University of Tennessee Medical Center in Knoxville. Harrison plans to address that concern in a second trial, comparing the outcome of the fetal procedure with that of conventional neonatal surgery. *– K.A. Fackelmann*