

Modern copies of the *Sushruta Samhita*, a collection of ancient Indian medical writings

The earliest known Indian civilization emerged around 2500 B.C. in the Indus River Valley. It was home to great cities such as Mohenjo-Daro and Harappa. Around 1500 B.C., warlike nomads called Aryans swept in from the north. The Aryans conquered Indian cities and established traditions that lasted into modern times. They developed a caste system that divided Indian society into different classes, based in part on people's work. They also developed the Hindu religion and a written language called Sanskrit.

Ancient Indian, or Hindu, medicine was called *ayurveda*, which means "science of life" or "knowledge of life." The word for physician was *vaidya*, or "he who has wisdom." Much of our knowledge about ancient Hindu medicine comes from two collections of medical writings. One, the *Sushruta Samhita*, was written by a surgeon named Sushruta. The other, the *Charaka Samhita*, was written by a physician named Charaka. *Samhita* means "collection."



Nobody knows exactly when these books were written. Ancient Hindus wrote on banana leaves and birch bark. These materials were fragile, and the original documents did not last long. Some historians believe that Sushruta lived around 1000 B.C. Others say he lived around 100 B.C.

Historians do know that by 326 B.C., when Alexander the Great and his army crossed the Indus River, Indian medicine was already very advanced. Experts believe that Indian medicine developed independently and was not influenced by the medicine of Greece or other contemporary civilizations.

PLASTIC SURGERY

The ancient Hindus lived under a harsh system of laws. Judges punished lawbreakers by ordering that parts of their bodies be cut off or mangled. Thieves might have a hand or an arm amputated. Liars might be burned on the face. To meet the needs of such people, Hindu doctors developed procedures for repairing disfigurement—a technology we now call plastic, or reconstructive, surgery.

Warfare also created a need for plastic surgery. Unlike the ancient Greeks and Romans, Hindu warriors did not wear protective helmets. Many soldiers thus had ears or noses cut off in battle, or suffered other disfiguring facial wounds.

Another reason for plastic surgery in ancient India came from the custom of piercing and stretching earlobes. Parents had their children's earlobes stretched to ward off evil spells and spirits. Physicians pierced earlobes with sharp instruments, then plugged and enlarged the holes with wads of cotton and wood. They also tied lead weights on

earlobes to stretch them. Such artificially shaped earlobes were thought to be beautiful.

Not surprisingly, holes in long, dangling earlobes tended to get caught on objects, and earlobes ripped open. Heavy earrings also tore earlobes. Ancient Indian surgeons learned to repair the damage and create a new earlobe. Modern plastic surgeons still use the same procedure on patients who lose earlobes because of cancer, accidents, or other problems. Here is how Sushruta described the technology:

A surgeon well-versed in the knowledge of surgery should slice off a patch of living flesh from the cheek-ear [the neck right behind the ear] of a person devoid of ear-lobes in a manner so as to have one of its ends attached to the former seat. Then the part, where the artificial ear-lobe is to be made, should be slightly scarified [scratched with a knife] and the living flesh, full of blood and sliced off as previously described, should be adhesioned to it.

One of the most basic procedures in modern plastic surgery is based directly on this ancient surgical technology. It involves cutting an area of skin and underlying tissue in the shape of a long U. The flap of tissue, called a pedicle flap, looks much like a tongue, with one end free and the other attached to the body.

Surgeons lift the free end, then sew it onto a damaged part of the body. First, they scrape, or scarify, the attachment site, as Sushruta advised, so the raw pieces of tissue can grow together. Once the raw surfaces have healed, the surgeons cut and free the base of the flap.

Ancient Indian surgeons even used the pedicle flap technique to create new noses for those who had lost theirs. From the unfortunate person's forehead, the surgeon cut a

triangular flap of tissue, shaped much like a kite. The broad end was lifted free from the forehead, and the narrow portion was left attached to the bridge of the nose.

The surgeon then lifted the flap down over the nose opening and stitched it in place. He produced new nostrils by molding the flap around two hollow tubes. The modern operation for nose reconstruction uses the same technique.

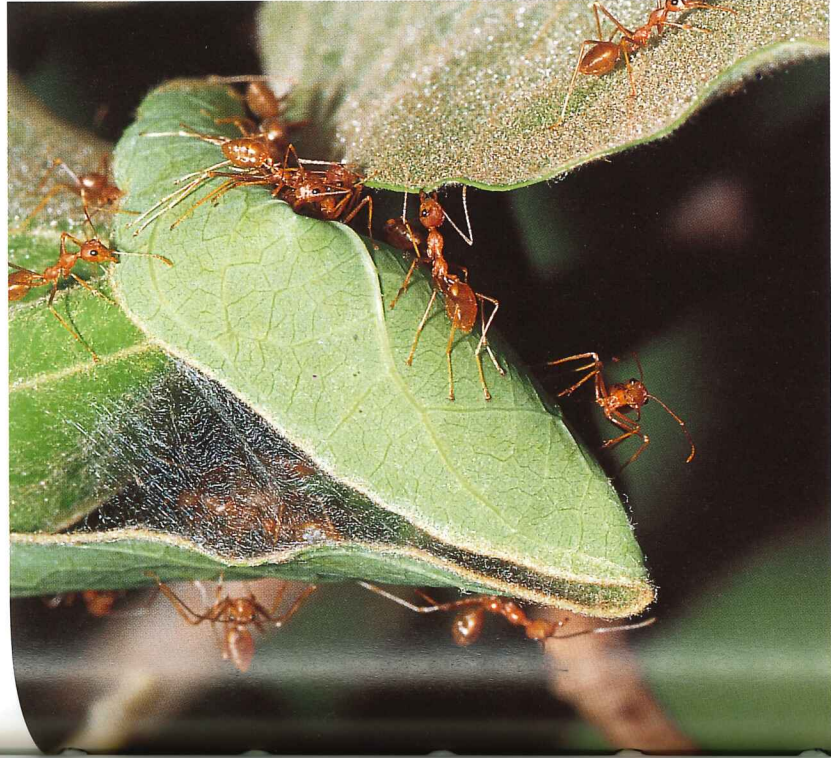
ANT SUTURES

Indian surgeons sometimes had to operate on the intestines after people were injured in battle or gored by animals. These operations were especially dangerous. When a surgeon stitched up an incision in the intestines, digested food or fecal material tended to seep out through the needle holes.

The sutures, or stitches, acted like wicks. Just as cotton string can draw water from a glass, early sutures—made of cotton, linen, silk, or other fibers—drew liquid out of the intestines. A single drop of such liquid, smaller than the period at the end of this sentence, contains millions of bacteria. The bacteria caused horrible infections.

Hindu surgeons developed an ingenious solution. Before starting intestinal surgery, they collected large Bengali ants. Some were almost an inch long. These insects will clamp down their powerful jaws to grasp food, enemies, or almost any object they touch.

The surgeons carefully held one ant at the very end of an incision and let it clamp down, drawing the cut edges of the intestine together. They placed another ant alongside. And another. And another, until ant jaws sealed the entire incision. Then the surgeons cut away the ants' bodies, and the jaws stayed firmly clamped in place.



Tailor, or weaver, ants use their strong jaws to make nests out of leaves. People have used this Indian species, *Oecophylla smaragdina*, to close wounds.

Sushruta advised surgeons how to proceed next: "After that the intestines with the heads of the ants attached should be gently pushed back into the [abdominal] cavity and reinstated in their original situation therein."

Surgeons then sewed up layers of muscle and skin in the incision with a needle and ordinary sutures. Within a few weeks, the patient's immune system would attack and destroy the ant jaws, turning them into liquid that the body absorbed. By that time, the intestines were safely healed. The Bengali ants are the forerunner of modern surgical

stapling, in which surgeons close intestinal wounds with stainless steel staples.

SPILLING THEIR GUTS

Indian surgeons had techniques for treating another messy and dangerous problem with abdominal wounds. Lengths of intestine, sometimes many feet long, often spilled out of wounds and hung outside the body. Left outside, intestines dried out and became infected. Infections caused slow, agonizing death.

For doctors, stuffing the slippery guts back into a wound was difficult. Sushruta suggested several ways of getting the intestines to retract, or slip back inside the abdomen. One of the most effective methods involved making the patient vomit. Vomiting caused the abdominal muscles to contract and literally sucked the guts back inside. Another technique was to have a strong man lift the patient into the air and shake him up and down.

Sushruta recommended that intestines first be washed gently with milk to prevent infection. If the intestines had already dried out, the surgeon was instructed to moisten them with a solution of milk and melted butter.

TEACHING AIDS

Modern doctors spend a great deal of time practicing surgical and other techniques. They must learn how hard to press down on scalpels and how tightly to pull stitches. They must develop hand-eye coordination and manual dexterity. They practice on cadavers (dead bodies) or animals rather than on living people. Plastic models also help prepare surgeons for treating real patients.

Ancient Hindu physicians also practiced their techniques on models. Student physicians practiced making incisions on watermelons and cucumbers. They stitched up pieces of animal hide to practice suturing human tissue. Young surgeons practiced amputating limbs of dead animals. They practiced lancing abscesses on leather bags filled with mud or water. They practiced cautery (burning wounds to prevent bleeding or infection) on pieces of fresh meat. Since there were no effective anesthetics to relieve pain in ancient times, it was very important for surgeons to perform their tasks quickly.

Indian surgeons had a wide assortment of instruments. The *Sushruta Samhita* lists more than 120 surgical instruments, including scalpels, forceps, probes, saws, needles, and retractors. Forceps took their names from the shape of their jaws. The lion forceps, for instance, had huge jaws for grasping big structures such as bones. The crocodile forceps had long, narrow jaws. Jaws of the hawk forceps were shaped like a scoop. The heron mouth forceps had long, narrow, sharply pointed jaws for removing splinters and other objects deep within wounds. Young surgeons practiced proper use of forceps by picking seeds out of different kinds of fruit.

PUBLIC HEALTH KNOWLEDGE

Ancient Indian physicians knew that patients themselves could do much to stay healthy. Indian doctors urged people to bathe regularly, brush their teeth, exercise, and eat a proper diet. They knew that flies transmit disease by landing on human and animal feces, then on food. So they advised people to avoid fly-infested foods. During



Wall relief showing an Indian surgeon operating on a man's leg

epidemics, widespread outbreaks of disease, doctors advised people to avoid drinking water and eating raw fruits or vegetables—since disease spread through water and raw food contaminated by feces.

SMALLPOX VACCINE

Many times throughout history, epidemics of a highly infectious disease called smallpox have swept through the

world. The disease, caused by a virus, has killed hundreds of millions of people and scarred or blinded even more.

Smallpox victims get a rash on the face and other parts of the body. At first the rash looks like thousands of small pimples. Then the pimples become larger and fill with pus. They break open and form crusty scabs that fall off. Each scab leaves a deep, craterlike scar. Smallpox was so common in earlier times that people often stood out in a crowd if their faces were not disfigured by its scars. Fortunately, after getting smallpox once, people develop lifelong immunity, or resistance, to the disease.

In 1796, Edward Jenner, an English physician, developed a vaccine to prevent smallpox. The last naturally occurring cases of smallpox appeared in 1977, and in 1980 the World Health Organization declared that smallpox had been eradicated, or totally eliminated, from the earth.

An ancient Hindu medical technology may have prevented many smallpox cases before Jenner's vaccine appeared. The Indians vaccinated people against smallpox with a technique called variolation. They took dried scabs from smallpox patients and applied them to the skin or inside the noses of healthy people. Sometimes, healthy people ate the scabs. The procedure exposed healthy people to the smallpox virus, so that they too developed lifelong immunity without getting the actual disease.

THE FIRST HOSPITALS

Television programs show that patients receive the very latest in high-tech medical care in hospitals. The idea of bringing sick or injured people to a central facility originated in ancient times.

Some of the first references to hospitals come from ancient India. An inscription carved into a slab of rock around 226 B.C. honored an Indian ruler named Asoka for building hospitals. Other records indicate that hospitals operated in what is now Sri Lanka, an island in the Indian Ocean, around 437 B.C.

We know very little about these hospitals. They may have been only temporary structures. The first permanent hospitals were built by the ancient Romans, several centuries later.

ANCIENT CHINA

