



He was just a teenager when he died. The last heir of a powerful family that had ruled Egypt and its empire for centuries, he was laid to rest laden with gold and eventually forgotten. Since the discovery of his tomb in 1922, the modern world has speculated about what happened to him, with murder the most extreme possibility. Now, leaving his tomb for the first time in almost 80 years, Tut has undergone a CT scan that offers new clues about his life and death—and provides precise data for an accurate forensic reconstruction of the boyish pharaoh.

Inside King Tut's subterranean burial chamber, against a backdrop of sacred murals, Zahi Hawass, head of Egypt's Supreme Council of Antiquities, removes padding to reveal the young pharaoh's remains. "When I saw his face, I was shocked," says Hawass. "My heart was pounding, and I could not speak." Moments later, workmen carried the mummy—still in the plain wooden box where British archaeologist Howard Carter placed it decades ago—to a trailer parked at the entrance of the tomb. There, a CT machine scanned the mummy head to toe, creating 1,700 digital x-ray images in cross section. Tut's head scanned in .62-millimeter slices to register its intricate structures, takes on eerie detail in the resulting image. With Tut's entire body similarly recorded, a team of specialists in radiology, forensics, and anatomy began to probe the secrets that the winged goddesses of a gilded burial shrine protected for so long.

Clues From Top . . .

Did the young pharaoh die from a blow to the head? Definitely not, say the nine doctors who studied the CT images. Some Egyptologists and amateur sleuths have long speculated that a stealthy foe murdered Tut by attacking him from behind.

As evidence, they cite an x-ray taken in 1968, which shows a fragment of bone (A) in the skull cavity—emptied by embalmers, according to custom. The CT scan, however, found no trace of lethal trauma to the head. A cross section reveals two loose pieces of bone (B and C), as well as additional chips embedded in the embalming resins that line the top and back of the skull. Packing material also appears near the ear canals and in the sinus cavities, and plugs close the nostrils. To remove the brain, pour in the resins—at two separate times—and stuff in the packing, the embalmers apparently entered the skull through the nose as well as the neck (D), perhaps breaking off bone in the process. Carter's handling of the mummy may also have produced bone fragments.

The maturity of the skeleton and wisdom teeth (E, one circled) confirms that Tut was about 19 years old when he died. His teeth had no cavities, and though his palate had a small cleft, he was probably unaware of it. The elongated shape of his skull—similar to that of other family members—was not caused by disease and falls within the range of normal variation.

. . . to Bottom

About five feet six inches tall (1.7 meters) and slightly built, Tut was in excellent health—well fed and free of any disease that would have affected his physique. Though his spine appears curved, it was probably misaligned during embalming. Something out of the ordinary, then, must have struck him down. But what? The experts can't say for sure because of the difficulty in distinguishing between possible injuries to Tut while alive and the damage Carter's team did to the mummy. Some believe, for instance, that a fracture above the left knee was Carter's fault. Others think it may be the result of an accident or assault that led to Tut's demise after a virulent infection set in and spread.

Tut's funerary equipment—including chariots, bows, arrows, and throwing sticks—indicates that he had learned to hunt and fight like a proper pharaoh. In addition, a painted wooden box (above) shows him defending Egypt from its enemies, a symbolic scene but maybe based in truth. Could he have died in battle? Or might he have crashed his chariot while hunting?

Supporters of such possibilities point to Tut's mangled chest, with its breastbone missing and much of the front rib cage cut out. Carter's anatomist notes that resin-soaked linen packed in Tut's chest prevented an examination—so the bones were likely not removed at that time. Did the embalmers take them out while preparing a gravely injured Tut for eternity? It's an intriguing question, but for now the pharaoh is still keeping some secrets.

Splendor of the Inner Sanctum

Carved into the Valley of the Kings, Tut's tomb hid his mummy and funerary regalia until archaeologist Howard Carter revealed its contents to world acclaim. Though the peripheral rooms were looted in antiquity, the burial itself remained untouched. The layered treasures included four nested boxes, or shrines, of gilded wood, then three mummy-shaped coffins—two gilded and one of solid gold—all inside a red quartzite sarcophagus. At the center rested Tut himself, with a stunning mask of gold

covering his head and shoulders.

Guide to the Great Beyond

Scenes infused with magical powers surround Tut's burial chamber and map out his journey to the next world. After the funeral procession, his successor, Aye, symbolically revives the dead king. Nut, the sky goddess, welcomes Tut to the realm of the gods, and Osiris, god of the afterlife, embraces him along with his ka, or spiritual double. Baboons on the far wall represent the start of his passage through the 12 hours of the night—a journey symbolized by a boat bearing a scarab, emblem of the sun god.

An angry wind stirred up ghostly dust devils as King Tut was taken from his resting place in the ancient Egyptian cemetery known as the Valley of the Kings. Dark-bellied clouds had scudded across the desert sky all day and now were veiling the stars in casket gray. It was 6 p.m. on January 5, 2005. In a few moments the world's most famous mummy would glide headfirst into a CT scanner brought here to probe the lingering medical mysteries of this little understood young ruler who died more than 3,300 years ago.

All afternoon the usual line of tourists from around the world had descended into the cramped, rock-cut tomb some 26 feet (8 meters) underground to pay their respects. They gazed at the murals on the walls of the burial chamber and peered at Tut's gilded face, the most striking feature of his mummy-shaped outer coffin lid. Some visitors read from guidebooks in a whisper. Others stood silently, perhaps pondering Tut's untimely death in his late teens, or wondering with a shiver if the pharaoh's curse—death or misfortune falling upon those who disturbed him—was really true.

When the valley closed to the public at dusk, Egyptologists in jeans and laborers in long robes and turbans got to work. Shouting directions and encouragements over the roar of fresh air being pumped into the tomb, they quickly attached ropes to the head and foot of the coffin lid and lifted it out of the sarcophagus. After a pause to reposition the ropes, they slowly pulled up a plain wooden box. Inside, cradled by cotton batting and yellowed muslin, lay the mortal remains of King Tutankhamun: a serene face with a scarred left cheek, a barrel chest, skeletal arms and legs, all blackened by resins poured on during his burial rites.

"The mummy is in very bad condition because of what Carter did in the 1920s," said Zahi Hawass, secretary general of Egypt's Supreme Council of Antiquities, as he leaned over the body for a long first look. Carter—Howard Carter, that is—was the British archaeologist who in 1922 discovered Tut's tomb after years of futile searching. Its contents, though hastily ransacked in antiquity, were surprisingly complete. They remain the richest royal collection ever found and have become part of the pharaoh's legend. Stunning artifacts in gold, their eternal brilliance meant to guarantee resurrection, caused a sensation at the time of the discovery—and still get the most attention. But Tut was also buried with everyday things he'd want in the afterlife: board games, a bronze razor, linen undergarments, cases of food and wine.

After months of carefully recording the pharaoh's funerary treasures, Carter began investigating his three nested coffins. Opening the first, he found a shroud adorned with garlands of willow and olive

leaves, wild celery, lotus petals, and cornflowers, the faded evidence of a burial in March or April. When he finally reached the mummy, though, he ran into trouble. The ritual resins had hardened, cementing Tut to the bottom of his solid gold coffin. "No amount of legitimate force could move them," Carter wrote later. "What was to be done?"

The sun can beat down like a hammer this far south in Egypt, and Carter tried to use it to loosen the resins. For several hours he set the mummy outside in blazing sunshine that heated it to 149 degrees Fahrenheit (65 degrees Celsius). Nothing budged. He reported with scientific detachment that "the consolidated material had to be chiseled away from beneath the limbs and trunk before it was possible to raise the king's remains."

In his defense, Carter really had little choice. If he hadn't cut the mummy free, thieves most certainly would have circumvented the guards and ripped it apart to remove the gold. In Tut's time the royals were fabulously wealthy, and they thought—or hoped—they could take their riches with them. For his journey to the great beyond, King Tut was lavished with glittering goods: precious collars, inlaid necklaces and bracelets, rings, amulets, a ceremonial apron, sandals, sheaths for his fingers and toes, and the now iconic inner coffin and mask—all of pure gold. To separate Tut from his adornments, Carter's men removed the mummy's head and severed nearly every major joint. Once they had finished, they reassembled the remains on a layer of sand in a wooden box with padding that concealed the damage, the bed where Tut now rests.

Archaeology has changed substantially in the intervening decades, focusing less on treasure and more on the fascinating details of life and intriguing mysteries of death. It also uses more sophisticated tools, including medical technology. In 1968, more than 40 years after Carter's discovery, an anatomy professor x-rayed the mummy and revealed a startling fact: Beneath the resin that cakes his chest, his breastbone and front ribs are missing.

Today diagnostic imaging can be done with computed tomography, or CT, by which hundreds of x-rays in cross section are put together like slices of bread to create a three-dimensional virtual body. What more would a CT scan reveal of Tut than the x-ray? And could it answer two of the biggest questions still lingering about him—how did he die, and how old was he at the time of his death?

King Tut's demise was a big event, even by royal standards. He was the last of his family's line, and his funeral was the death rattle of a dynasty. But the particulars of his passing and its aftermath are unclear. "This period is like a play," Zahi Hawass explained in his busy Cairo office before the scan. "A part of this play is written. But the final scenes are not known."

These things we do know: Amenhotep III—Tut's father or grandfather, depending on how you read the evidence—was a powerful pharaoh who ruled for almost four decades at the height of the 18th dynasty's golden age. His son Amenhotep IV succeeded him and initiated one of the strangest periods in the history of ancient Egypt. The new pharaoh promoted the worship of the Aten, the sun disk, changed his name to Akhenaten, or "servant of the Aten," and moved the religious capital from the old city of Thebes to the new city of Akhetaten, known now as Amarna. He further shocked the country by attacking Amun, a major god, smashing his images and closing his temples. "It must have been a horrific time," said Ray Johnson, director of the University of Chicago's research center in Lux-

or, the site of ancient Thebes. "The family that had ruled for centuries was coming to an end, and then Akhenaten went a little wacky."

After Akhenaten's death, a mysterious ruler named Smenkhkare appeared briefly and exited with hardly a trace. And then a very young Tutankhaten took the throne—King Tut as he's widely known today. The boy king soon changed his name to Tutankhamun, "living image of Amun," and oversaw a restoration of the old ways. He reigned for about nine years—and then died unexpectedly.

A crisis of succession gripped the royal court. With power plays and intrigues surely seething around her, Tut's widow, Ankhesenamun, appears to have launched a coup of her own, sending desperate letters to the king of the Hittites in Anatolia. "My husband is dead," she wrote. "Send me your son and I will make him king." It was an unprecedented request, but understandable. "Her grandmother was Queen Tiye, one of the most powerful queens Egypt ever saw," Ray Johnson explained. "Her mother was Nefertiti. They ruled as living goddesses, so of course Ankhesenamun felt she had the same power. And she found out that she didn't."

A Hittite prince, Zannanza, was eventually sent south to marry her, but he was killed—by a hit squad, some speculate—as he entered Egyptian territory. An elder courtier named Aye, possibly Ankhesenamun's grandfather, then became pharaoh. Was he an honorable official who stepped into the top job in the sudden absence of an heir? Or did he callously plot Tut's death for his own advantage? Either way, he reigned for only three or four years. When he died, army commander Horemheb took control.

The new ruler, a man of great ambition, had risen to the throne from obscure beginnings. Did he conspire with the aged Aye to eliminate Tut and the Hittite prince, and then bide his time until Aye's death? He had the motive, the opportunity, and the power. In any event Horemheb, still sadly childless late in his reign, named as crown prince his old army buddy Ramses, who became the founder of a new dynasty.

Egyptologists put little stock in conspiracy theories, but tales of intrigue have captured the imagination of countless King Tut sleuths, who cite the circumstantial evidence against Aye, Horemheb, and even Tut's wife, Ankhesenamun, as well as clues from the burial. For starters, Tut's tomb is unusually small for a king, and its contents were crammed in. Carter noted that the nested shrines surrounding the sarcophagus "had obviously been banged together, regardless of the risk of damage." In addition, workmen had hacked at the mummy-shaped outer coffin to make it fit into the sarcophagus. These factors, and more, make a litany of haste—but do they testify to murder?

King Tut could easily have succumbed to an infection or illness. Letters from that era record that a plague—as yet unidentified—ravaged Egypt and its neighbors. An accident is another possibility. It's easy to imagine Tut at the reins of a chariot feeling a young man's need for speed. He hits a bump, flies through the air, and lands with a deadly crunch. Could such a fall have damaged his breastbone and ribs so badly that the embalmers had to remove them?

Regardless of his fame and the speculations about his fate, Tut is one mummy among many in Egypt. How many? No one knows. The Egyptian Mummy Project, which began an inventory in late 2003,

has recorded almost 600 so far and is still counting. The next phase: scanning the mummies with a portable CT machine donated by the National Geographic Society and Siemens, its manufacturer. King Tut is one of the first mummies to be scanned—in death, as in life, moving regally ahead of his countrymen.

The night of the scan, workmen carried Tut from the tomb in his box. Like pallbearers they climbed a ramp and a flight of stairs into the swirling sand outside, then rose on a hydraulic lift into the trailer that held the scanner. Twenty minutes later two men emerged, sprinted for an office nearby, and returned with a pair of white plastic fans. The million-dollar scanner had quit because of sand in a cooler fan. "Curse of the pharaoh," joked a guard nervously.

Eventually the substitute fans worked well enough to finish the procedure. After checking that no data had been lost, the technicians turned Tut over to the workmen, who carried him back to his tomb. Less than three hours after he was removed from his coffin, the pharaoh again rested in peace where the funerary priests had laid him so long ago.

Back in the trailer a technician pulled up astonishing images of Tut on a computer screen. A gray head took shape from a scattering of pixels, and the technician spun and tilted it in every direction. Neck vertebrae appeared as clearly as in an anatomy class. Other images revealed a hand, several views of the rib cage, and a transection of the skull. Analysis by a team of radiologists would take several weeks to complete—and would reveal no conclusive evidence for murder. But for now the pressure was off. Sitting back in his chair, Zahi Hawass smiled, visibly relieved that nothing had gone seriously wrong. "I didn't sleep last night, not for a second," he said. "I was so worried. But now I think I will go and sleep."

By the time we left the trailer, descending metal stairs to the sandy ground, the wind had stopped. The winter air lay cold and still, like death itself, in this valley of the departed. Just above the entrance to Tut's tomb stood Orion—the constellation that the ancient Egyptians knew as the soul of Osiris, the god of the afterlife—watching over the boy king.

Treasures of a Golden Age

Tut's throne shows a rare intimate scene: his wife rubbing him with perfumed oil. For the first time since 1981 some of the masterpieces from his tomb are now on tour. "Tutankhamun and the Golden Age of the Pharaohs," a National Geographic exhibition, opens June 16 in Los Angeles and includes his diadem, gilded statues, and an alabaster cup inscribed with hieroglyphs that read: ". . . may you, who love Thebes, spend millions of years with your face to the north wind, and may your eyes see joy."