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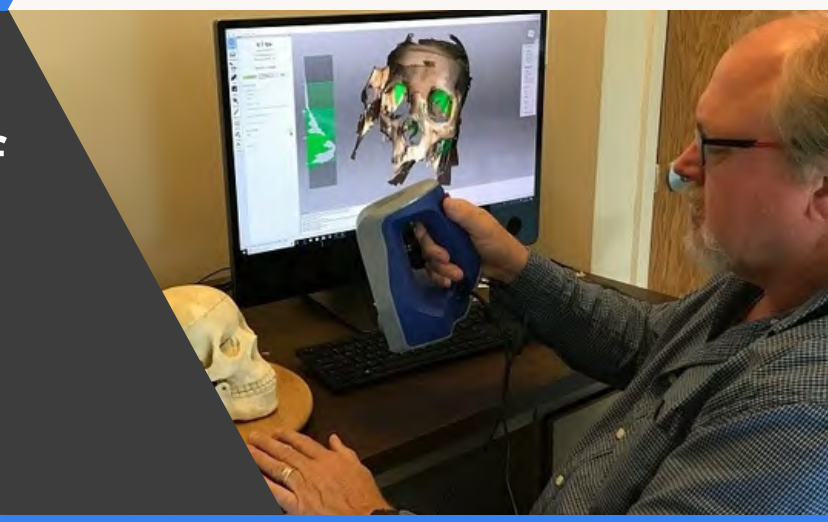
Artec 3D

Illuminating the field of forensic anthropology with Artec 3D scanners



Summary: A leading forensic anthropologist needed a way to 3D scan bones, skeletons, and entire death scenes quickly, with a minimum of post-processing work.

The Goal: To use a trio of professional 3D scanners at forensic death scenes, to digitally capture in high-resolution color everything from the bones themselves, all potential evidence, to the surrounding ground, leaves, landscape, etc.

Tools Used: Artec Space Spider, Artec Leo, Artec Ray, Artec Studio

Forensic Anthropologist Dr. Dennis Dirkmaat, PhD in his office at Mercyhurst University

In most places around the world, when police find a dead body or skeleton out in nature, they often quickly bag it up and haul it away. Then back at the forensics lab, or the coroner's office, they examine the remains and try to determine the cause of death and other details. If you ask a forensics anthropologist about this, they'll tell you that it's like picking up an apple that's fallen from a tree, carrying it away somewhere, then studying that apple to try and understand how it grew, where it came from, and even to know about the apple tree itself.

In the words of forensic anthropologist Dr. Dennis Dirkmaat, "When it comes to outdoor death scene investigation, context is hugely underrated." He went on, "Extremely crucial information can be found at the scene where the body is discovered, but usually that information is entirely ignored by investigators...and yet if you know what to look for, that scene can speak to you, and this can make the difference between understanding if there was a crime there or not...and if there was, let's just say the evidence can be more than eye-opening at times."

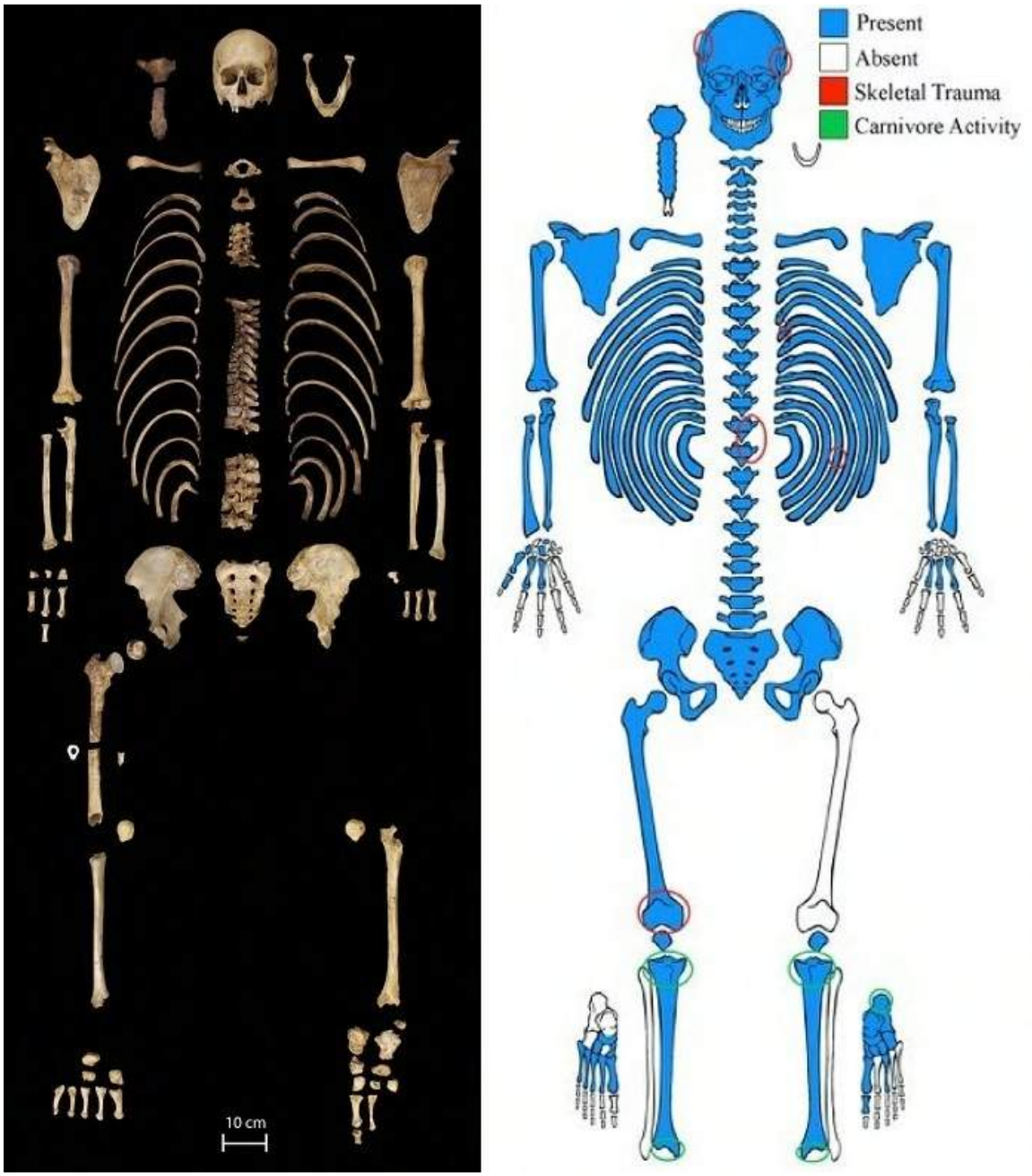
Death scene as found, prior to forensic archaeological recovery of the evidence.

For more than two decades now, Dr. Dirkmaat and his students have been called in to help police and coroners on an average of 100 outdoor crime scenes every year. Once there, they begin their meticulous search, turning over every leaf and stone, scrutinizing every patch of dirt and blade of grass as they locate and mark the spatial distribution of the remains and any associated materials through detailed maps.

Human remains on a forensic scene with evidence markers in place, following removal of vegetation and prior to mapping.

In the lab, Dirkmaat is adept at looking at bones and understanding what kind of trauma they experienced, both before and after death. He imparts this wisdom to his students, who, over the course of months, learn how to tell whether the person died from natural causes, was killed, or took their own life. And in cases where remains are found scattered, buried, or burned, to ascertain whether the bones and the evidence have been moved by animals, water, wind, gravity, or purposely moved by someone else.

In terms of the human skeletal remains, an essential phase of Dirkmaat's investigation includes the use of a handheld 3D scanner to digitally capture the bones. He turns these scans into color 3D virtual models for more detailed, close-up examination, as well as archiving them for use in his newly created "Bone Encyclopedia," which he hopes will quickly become an invaluable reference database for investigators near and far, allowing them to search and visually analyze any of thousands of bones for key characteristics and details, and then compare these with bones and remains in their own cases.



Bones recovered/missing from death scene, with trauma and carnivore activity detailed

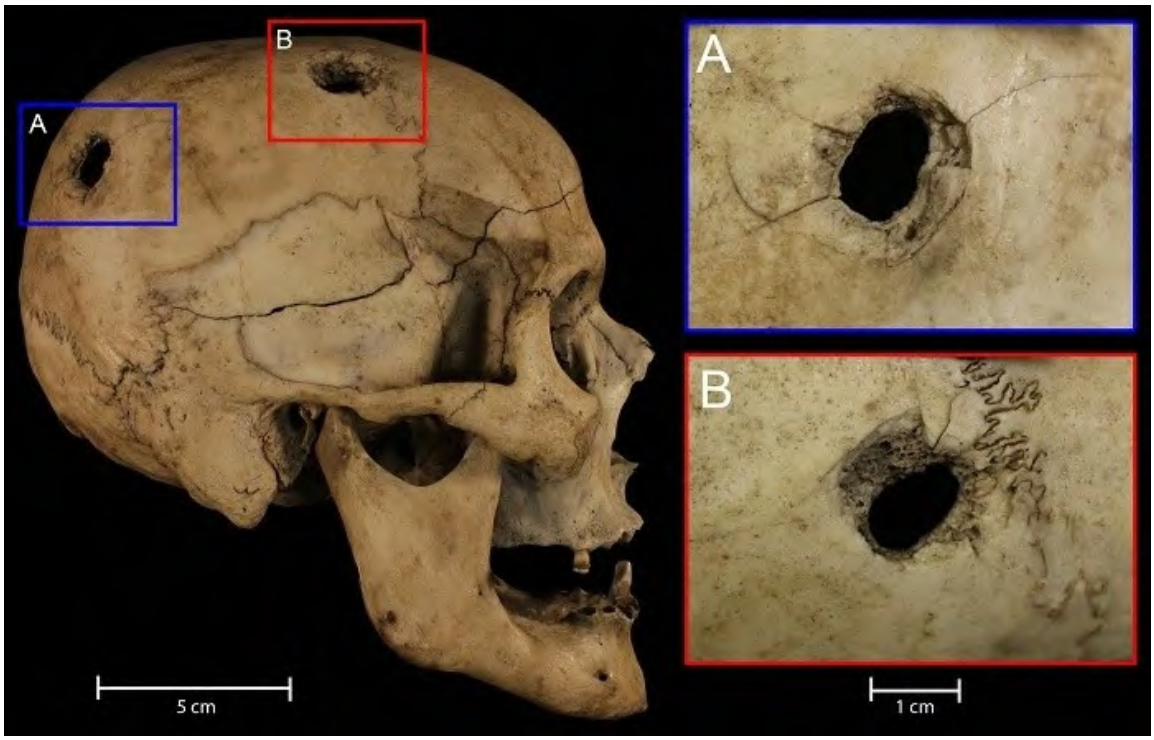
In the past, Dirkmaat was using a NextEngine 3D scanner to create 3D virtual models of bones. Although the scanner was very affordable up front, the scanning process was lengthy, demanding an entire afternoon, if not longer, to scan a standard set of skeletal remains. And often there was a significant amount of digital noise in the scans, making extensive post-processing an everyday activity.

Skull scanned from a variety of angles, with trauma and entry/exit gunshot wounds visible

Dirkmaat knew there must be a better way. He was introduced to the Artec Space Spider, a handheld ultra-resolution 3D scanner that has been the chosen solution for digitally capturing small objects with complex geometries and high levels of detail. With a point accuracy of up to .05 mm (50 microns), Space Spider brings a level of detail to forensics that goes well beyond what the human eye can perceive.

Dr. Dennis Dirkmaat scanning with Artec Space Spider

Once Dirkmaat saw how easily Space Spider could capture bones, he made his decision. “In terms of the scanning itself, I was astonished with how quickly Space Spider captured the set of bones we were scanning. In one pass, everything was scanned. And afterwards, when we looked at the scans and saw how clean and detailed they were, I realized that my search was over, I had found my solution,” he said. “Then when I got my Space Spider and put it to work in the field, what I saw the first day was that, even though I was a beginner with the scanner, what used to take a full afternoon with my old scanner, now took me only an hour or less. To say that I’m highly pleased would be an immense understatement.”



Death scene as found, prior to forensic archaeological recovery of the evidence.

Following scanning, the 3D scans are post-processed in Artec Studio, the scanner’s software for registering and aligning scans. It also lets you export the 3D models in a variety of formats as well as directly to the most popular CAD systems and other applications.

Dirkmaat believes that Space Spider is, in his words, a “perfect fit for the field of Forensic Taphonomy,” the study of the multiple and overlapping processes (and the changes they bring) affecting skeletal remains beginning around the time of death and continuing for days, weeks, and even years to come. Some of the changes are visible, others invisible (except via microscope). All can be observed and interpreted by an experienced investigator.

And the myriad patterns they form can reveal oftentimes shocking details of how a death took place. “Space Spider is a tremendous help for the forensic investigator,” said Dirkmaat, “in that it quickly and easily captures bones in full color, submillimeter 3D, which means that you can reach such high levels of detail and positively identify these patterns of changes great and small.”

As Dirkmaat said, “We’re just at the beginning when it comes to 3D scanning in forensics, and in my field of focus, forensic anthropology… We will soon see 3D scanning used for capturing the entire scene of death, so everything surrounding the bones, all the ground and leaves and whatever else is there will be digitally captured exactly as it was when the discovery was made…this way even long after the scene has been altered, due to weather, time, and of course, human intervention, we’ll still be able to read that scene for those telltale clues that will speak in abundance about what really happened there.”

To achieve this, Dirkmaat has recently begun scanning with Artec Leo, an easy-to-use handheld 3D scanner that’s totally wireless, without the need to be connected to a computer while scanning. Users can simply pick up and go, scanning in darkness or bright daylight, or anything in between. With a built-in touchscreen to monitor scans in real time, you can quickly see if any areas need rescanning. And with an unequalled digital capture frame rate, together with a sweeping field of view, Leo scans fast, giving users color, high-definition results of medium to large objects in mere minutes.

Another Artec scanner that Dirkmaat has begun working with is the Artec Ray, a metrology-grade, long-range LiDAR 3D laser scanner that rapidly captures large objects and even entire scenes and landscapes, at a maximum range of 360 feet (110 m). With a data capture speed of 208,000 points/second, in just a few minutes, Ray can scan outdoor (or indoor) death scenes with submillimeter accuracy.

By combining the trio of Artec Space Spider with Artec Leo and Artec Ray, Dirkmaat has found an effective solution for digitally capturing the entire scene of death in extraordinary detail. With Space Spider providing the accuracy needed for capturing the organic geometries and intricacies of bones, and Leo giving users the power to quickly scan medium-large objects such as a grave, or even a car, in high-resolution color, together with Artec Ray, which lets investigators quickly scan the scene of death, from the body itself up to hundreds of feet away, everything is covered. Artec Studio lets users easily merge scans from all three scanners, resulting in breathtakingly lifelike 3D models.

A recent and exciting development in the field of forensics that Dirkmaat believes Artec scanners are ideal for is 3D scanning and printing lifelike copies of bones. Quite often throughout courtroom proceedings, not to mention during ongoing investigations, having the actual bones present can be a decisive factor in the outcome of a case. Yet doing so can prove problematic, not merely due to the high risk of damaging the bones and/or corrupting the evidence in some way.

3D scanning changes all that. By creating perfectly lifelike digital copies of the bones and then 3D-printing them, it's finally possible to have exemplary replicas of the bones that will stand as evidence in court and be vital tools for investigators. Not to mention that the digital nature of the process allows researchers and investigators everywhere to make use of this leap in technology.

For example, if police in France want to compare some human remains showing signs of defensive trauma found in the French Alps with bones in similar conditions found elsewhere in Europe or even abroad, they can now request 3D models of those other bones, and in a few short hours have their own lifelike replicas for comparison and examination.

"Artec has truly changed the face of forensic anthropology with Space Spider, Leo, and Ray. I've integrated Artec's solutions into my daily field work as well as my regular and special classes for investigators, law enforcement officers, and college students, and the results have been nothing short of spectacular. My students pick up the scanning process quickly, and the levels of detail we get now, especially considering the little time needed for doing so, are truly remarkable," said Dirkmaat.