

■ REVIEW ARTICLE

## Physical Indicators of a Grave: A Review

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### ABSTRACT

The observable characteristics or the geographical indicators of a burial site can help locate the buried remains. The investigator has to use every available technique in the search and hence needs training in search techniques. Several factors can influence the appearance of a grave. Deliberate burials tend to leave surface evidence and are commonly revealed as a depression. Unidentified graves can also be detected by plant growth, animal signs and other surface objects or indicators. Soil anomalies (depressions and cracking) are more pronounced at larger grave sites versus the smaller grave. The objective of our article is to review these processes and provide guidance as to which search, or instrument technique will be an effective strategy for locating graves.

Keywords | Buried remains; Clandestine grave; Indicators; Grave; Ground Penetrating Radar.

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### INTRODUCTION

When a murder has been committed and the remains of this individual are buried, the law enforcement agency in charge of the investigation has to use every available technique or method in the search for the remains. The law enforcement agency needs training in search techniques, but these techniques may not be effective enough when searching for buried human remains.<sup>1</sup> Indicators for murder victim in clandestine graves have gathered interest of both investigators and researchers.<sup>2</sup> Forensic Taphonomy plays an important role in the location of clandestine graves from the effect that decomposition has on the burial site, and it can be used to locate these sites. The Soil might be mixed up at the location of grave and vegetation on the grave will differ from the surrounding.

Animal scavenging also plays an important role in the location of clandestine graves. The Presence of disturbed soil or burrows and holes makes it a potential site of possible human remains. Along with the above



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indicators, presence of clothing or bones on the soil surface can help investigators in detecting a possible grave. Indications of clandestine graves can also vary between climate, season, and soil type. Surface deposits that are which are either completely or partially exposed can be classified as primary or secondary burial sites.

Several factors can influence the appearance of a grave. Wind, water, ploughing of a field, soil conditions and depth of the burial will all play a role. Apart from these physical indicators, the processes associated with the decomposition need to be understood. Moreover, the preservation of organic materials plays a significant role in archaeology as well as forensic science.<sup>3</sup>

#### Soil Surface

Soil may be levelled to the surface after burying, but it will always form a depression in the area where the remains are buried. This kind of a depression called primary depression is largely due to the subsequent downfall of the buried body and partly due to decomposition. The largest volume to collapse during the decomposition process is the thorax abdominal area which may give rise to a secondary depression. Usually there is no vegetation seen on a newly formed grave. The decomposition of the body may leave certain nutrients in the soil to give favourable conditions for plants to grow and these plants may actually grow faster than the surrounding vegetation. Normally weeds and grasses are the first plants to appear on a new grave as they are fast growers and are easily differentiated from surrounding vegetation.<sup>4</sup>

Disturbing the ground creates alterations in the vegetation which may alter the local flowering regime.<sup>5</sup> In the case of filling the grave, the mounding phenomenon is tried to be omitted by flattening the surface over the grave. However gradually the soil will consolidate and sink causing a hollow over the grave. Differences can be measured using geophysical survey techniques and processed later using appropriate software such as catographic analysis, aerial photography,

field observation etc. A shallow grave may have characteristics of both contexts since some bones may be scattered on the surface due to erosion or disturbance, while other remain beneath the soil.<sup>6</sup>

#### Animal Scavenging

Animal scavenging is another important sign in cases where the grave is shallow. In certain cases, these animal activities help in detection and recovery of human remains. Any fresh digging caused by racoons or opossums and dogs should be investigated. Birds and rodents tend to carry off hairs and bits of clothing to use as their material for burrow or nests. Scavenger birds also tend to congregate near a body. Coyotes and dogs may carry body parts or bones from their concealed or buried location out in the open where they can be easily detected.<sup>7</sup> There is also the possibility that some personal belongings or bones are brought to the surface due to the digging of the animals. Various environmental, individual, and cultural factors may have an impact on these physical indicators.<sup>8</sup>

#### Surface Deposits

Surface deposits, the types of burials also are primarily important.<sup>8</sup> Location of remains also determines a forensic context to a large extent. In a primary burial site, the body remains in its original location and is undisturbed. A secondary burial site indicates that the remains have been moved from their original site and deposited.<sup>9,10</sup> Excess soil is usually scattered around the edges of the grave or left with no attempt to level the surface with the surrounding area, resulting in a small ridge or rise next to the grave. Usually, environmental factors and taphonomic processes will destroy the tissues within a period of time, but if found then it might be a possible indicator of a grave. Associated artifacts and evidence like weapons, digging tools, concrete blocks, clothing, wrapping materials are generally used to cover the surface deposits. It may indicate a possible grave of a forensic context. In cases where a body is buried at a shallow depth or buried in a natural depression, extra holes may be dug

around the burial site to gather enough soil to completely conceal the body. This might be another possible indicator to suspect a grave.

### **Geophysical Characteristics**

A study in which the importance of training in archaeology and archaeological methods was discussed, has led to a significant which has improvement in the recovery of burials considering certain surface evidences.<sup>11</sup> The geophysical characteristics include stratification evidence, tool marks on the burial pit edge, bioturbation of the deposits, sedimentation factors, surface compression and depression of the burial pit deposits, and internal compaction of the burial pit deposits.<sup>12</sup>

### **Non-invasive search and detection techniques**

Non-invasive search and detection techniques also play a major role to locate and identify graves. The recognizable signs of a scene are natural/disturbed vegetation, soil features and topography of soil and corresponding artifacts. If a buried feature is suspected, a trowel can be used to identify differences in soil texture, coloration, and composition with surrounding soil. Visual signs include discoloured areas of substrate marked by odour or discoloration from body fluid leakage, presence of insect puparium, and yellowish discoloration of low, overhanging deciduous foliage.<sup>13</sup>

### **Vegetative Markers and Ornamental Vegetation**

The importance of vegetative markers and ornamental vegetation play an important role in preliminary identification. The Presence of a cemetery can be indicated by the presence of flowering and/or fruiting trees, camellias, roses, daffodils, lilacs. Periwinkle is commonly found as an ornamental plant at cemeteries in the south-eastern U.S<sup>14</sup>

The vegetation dynamics of a burial site using five swine carcasses was carried out in Italy by burial of the carcasses to detect the effects of mechanical disturbance and carcass decomposition on vegetation structure and specific composition. After the

burial, *B. sterilis*, *C. caryophylla*, *Euphorbia cyparissias*, *Teucrium chamaedrys*, *V. myuros*, and the moss *Schistidium apocarpum* were significantly more abundant in the undisturbed control plot than on the graves.<sup>15</sup>

### **Clandestine Grave Detection Techniques**

Various techniques of clandestine grave detection are used like changes in vegetation, chemical analysis of volatile organic compounds (VOCs), human remains detection (HRD) dogs and ground penetrating radar. The release of purge fluids into the soil kills the surrounding vegetation. As decomposition of the purge fluids progresses, releasing carbon, nitrogen and phosphorus to the grave soil, vegetation may be more abundant at the grave site than other vegetation in the area.<sup>16</sup>

After the weed invasion these are replaced by a species of plant which is very different from the vegetation present in the surrounding area. Chemical alterations includes enrichment of the soil due to decomposition of the body and also aeration of the soil during the inhumation process which typically manifests in form of darkened or stained soil. The cadaver dogs are trained to detect the odour of decomposing human remains and alert their handlers regarding the location of these decomposing human remains.<sup>17</sup>

### **Soil Changes**

At the time of decomposition, materials from a cadaver enter grave soil providing a localised infiltration of nutrients which results in the formation of cadaver decomposition island. One of the major characteristic features of this island is increased soil microbial biomass and microbial activity.

The changes associated with these include an increase in nitrogen concentrations in soil as well as plants. Calcium concentrations and pH are found to be higher directly underneath the carcass with a gradient decrease towards the periphery of the decomposition site. This effect is detectable for up to seven years after the death of the animal.<sup>18-19</sup>

## NON-INTRUSIVE WAY OF SEARCHING FOR A BURIAL

### Probe

The probe is a relatively non-intrusive way of searching for a burial. Probes are an easy to use, inexpensive and accurate way of narrowing down a search area for a burial. The regular metal probe is the least expensive, but other probes are just as good to use. The gas probe has a sensor that can detect gases that are released from a decaying body. Certain gases are released from these decomposing bodies and a gas probe, when inserted into the ground, may be able to pick them up. Another type of probe is the soil temperature probe. Decomposing bodies have been shown to raise the temperature of the surrounding soil by a few degrees. This can be detected by using subsurface soil temperature probes. The last type of probe that could be used is a soil pH probe. Besides increasing the temperature of soil around a burial, decomposing bodies have also been known to increase the alkalinity of the soil around a burial. Soil pH probes can be used to measure this increased alkalinity and possibly detect a burial.<sup>20-21</sup> The main disadvantage of the probe is that the searchers using the probe need to be trained in how to handle and use it properly.

### Shovel Test

By digging down this far archaeologists can determine if the stratigraphy of the soil is natural or reversed. If there is a possible burial a properly trained and cautious archaeologist may dig in 10 cm intervals only, causing little or no damage to anything that may be buried.<sup>22</sup>

### Metal Detector

When using a metal detector to locate a buried body the assumption is that there will be metal objects on or with the body. Compared with some other methods used, metal detectors are relatively cheap. The commonly used metal detectors contain a transmitter, powered by a battery that radiates a low frequency signal

into the ground by means of a coil that is placed at the bottom of the metal detector. When the low frequency current signal reaches any metal or mineral that is in the soil, the metal or mineral re-radiates a signal back to the surface. This signal is what the metal detector's receiving coil picks up. Metal detectors have a few disadvantages too. First, they can detect only metal material (ferrous, nonferrous), and only to a few feet in depth. The depth at which the detector can react to metal depends on the coil size and the size of the metal object.<sup>22</sup> Large metal objects can be detected at a deeper level than small ones, which can be detected only if they are close to the surface.<sup>23</sup>

### Ground Penetrating Radar (GPR)

Ground Penetrating Radar (GPR) is a technique that is becoming more widely available to archaeologists in the field. GPR sends electromagnetic waves into the earth then records the energy that is reflected back from materials located below ground. A short pulse is used to allow accurate measurements of depth to the target. The echoes that are reflected are displayed on an oscilloscope.<sup>24</sup> One disadvantage is that the GPR works well only in smooth areas with a constant elevation.<sup>20</sup> The Smooth level ground cannot be guaranteed when an archaeologist is working in the field. Another disadvantage to using GPR is that the equipment that is needed is very hard to obtain and relatively expensive.<sup>24</sup>

GPR is capable of measuring both physical and chemical changes in the ground in three dimensions; therefore, depth as well as the spatial distribution of graves can be determined.<sup>25</sup> Depth in the ground can also be determined. Energy is reflected from any discontinuity in the ground, including mineralogical differences, sediment size distinctions, void spaces, concentration of associated artifacts. Amplitudes of the reflected waves can also be measured, indicating differences in material properties within the ground, that is significant in locating subtle buried features.<sup>25-26</sup> The greater the contrast in electrical properties

between any two buried materials at an interface, the greater will be the amplitude of recorded signals.<sup>27</sup> The advantages such as depth of burial, grave size, type of caskets and their orientation, numbers of graves in certain locations, and the spatial distribution of graves within certain areas of cemetery may provide crucial help to the forensic investigators.<sup>28</sup>

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### CONCLUSION

The observable characteristics or the geographical indicators of the burial site can help locate the areas of interest. Several factors can, of course, influence the appearance of a grave. The processes associated with the decomposition is of great importance to forensic science and archaeology as it can be used to establish cause and manner of death, provide the location of human remains and can also provide

means to determine post-mortem interval. There are various techniques are used for the detection of clandestine graves, like physical characteristics of graves, chemical analysis of volatile organic compounds, cadaver detection dogs, etc. The most common are magnetic radiometry, electrical resistivity, GPR, and electromagnetic conductivity of which GPR is the best method.

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