

Benefits of ear prints in personal identification

[Law](#), [Crime](#)



Abstract

Every substance in the crime scene when observed carefully can aid in investigation. Many evidences were put forth by the studies which can be obtained from the crime scene. One among them is the research regarding the consideration of ear print as valuable evidence, when correlated properly can be useful as the one among the other impression evidence. Ear prints can be found in crime scene when done intentionally like burglary where the perpetrator listens into the house to understand the scenario, and other situations where the latent prints were left in the crime scene. The main aim of this study is to spread the significance of the morphology of the ear and variations occurring in them to aid in personal identification and exclude the innocents from a group of suspects in crime. The literature is reviewed in the context of forensic science, to study the differences among the population of young adults in both the genders. Some significant differences were found between the prints of male and female origin which help in forensic investigation as a supportive tool.

Key words: Personal identification , forensic science , evidence , variations.

Introduction

Ear prints are the impressions formed when the external pinna of the ear gets in contact with the surface. Different substances like oil, waxes are left behind on the surface marking the structure of auricle of the ear which are to be developed using different techniques to make them visible. Hirshi in the year 1970 was among the first to propose the value of ear prints in the personal identification. In the following years many researches were done in

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the context of forensic identification from the ear prints recovered from the crime scene. If we further look into the history of ears and ear prints it is the Darwin, who attracted the scientific world regarding the ear, during his research about the relation with primates, by saying that the ear is one of the elementary organs. To prove for his position he pointed at the broadening of the middle of the helix (auricular tubercle), indicating that this is nothing else but a corner of the primitive ear which is reducing. Science recognised his work and tributed this part by naming it “ tubercle of Darwin”.

Professor Doctor G. Schwalbe was one of the first to invent a method to measure the external ear. He was able to prove the theory of Darwin. He also was the first to attract scientific attention to the racial peculiarities in the structure of the ear. Ear prints usually gives leads for the investigation in the direction of estimating the individual’s height based on the location of the print. Ear print evidence was first used in Holland in 1986 but the court accepted it only as supportive evidence. Mark Dallagher, 28, was the first person to be convicted using the technique when he was found guilty of killing Dorothy Wood in May 1996 at her home in Huddersfield. He was sentenced to life imprisonment when his case was heard at Leeds Crown Court in December 1998. This is the first case of conviction on the basis of ear prints. Ear also comes into play when it is the sole evidence for linking the crime and the perpetrator. Especially in cases like burglary when someone listens in to the house before breaking into leaves the prints on the surface.

Studying the morphology helps understand the variations in different individuals of population. Ears can be used in identification of unknown persons especially in cases of mass disasters, burns, drowning etc. where the face is severely disfigured. Basing on statistical calculations, demonstrating conformity of 7 characteristics in evidential and comparative impression has been decided as sufficient to conclude that they come from the same person. The outer ear constitutes of the cartilaginous bones and structures covered with teguments. The cartilage lamina is folded into itself forming a protuberance and depression that gives the outer ear its characteristic shape. Numerous studies carried out in the world have demonstrated that the shape of auricle generally does not change throughout human life and this organ is not very much prone to injury.

In this paper, the need for the study of ear prints is the necessity of ear prints to the forensic investigation for individualization is discussed reviewing the articles published on the same. Morphology of the ear: In mammals, ear is usually described to have three parts-outer ear, middle ear and inner ear. Outer ear consists of fleshy part (pinna) and the ear canal. Since the outer is only visible portion, it is referred as ear. The external ear consists of skin (with adnexa), cartilage, and six intrinsic muscles. The pinna consists of the outer rim which is curved called as helix and inner curved rim is called anti helix.

The purpose of forensic investigation and individualization on the basis of ear morphology can be fulfilled only through keen knowledge about the morphology of the ear. A Y-shaped curved cartilaginous ridge arising from

the inner corner near the canal and separating the concha, triangular fossa, and scapha is called the anti helix. It represents a folding of the cartilage and it usually has similar prominence to a well-developed helix. The stem (the part below the bifurcation) of the normal antihelix is gently curved and branches about two thirds of the way along its course to form the broad fold of the superior (posterior) antihelical crus, and the more sharply folded inferior (anterior) crus. The inferior and superior crura of the antihelix can vary both in volume and degree of folding.

The lower cartilaginous ridge arising at the bifurcation of the antihelix that ends beneath the fold of the ascending helix, and separates the concha from the triangular fossa is inferior crus and the upper cartilaginous ridge arising at the bifurcation of the antihelix that separates the scapha from the triangular fossa is superior crus. The soft fleshy part is the lobe. The ear lobe is highly variable in size and in the degree of attachment of the antero-inferior portion to the face. The groove between the helix and the antihelix is scapha and A posterior, slightly inferior, protrusion of skin-covered cartilage, anterior to the auditory meatus is called tragus. The concavity bounded by the superior and inferior crura of the antihelix and the ascending portion of the helix is triangular fossa.

Variation and stability of auricle

Variations may be intra individual and inter individual which include both qualitative and quantitative features of entire structure of the ear or their individual components. Some of the sources for the intra individual variation are the way the prints are left, which surface bears the prints, influence of

the force or pressure on the ear due to surface. Neubert in the year 1985 compared the dimensions of the print with that of the auricle. he did so by involving fifty subjects and took prints of both the ears in two levels, one on soft surface and other on hard surface. He then noticed the difference in the prints with varying pressure when applied on them.

The difference observed was increase in the size of the pinna when there was more pressure and decrease when the pressure was decreased. The other finding was the increase in the length was more when compared to the width in the upper part, but the deviation was observed to be reverse in the case of ear lobe. The width change is more than the length change in the case of the ear lobe. Saddler(1996) studied the influence of changes in applied force on the various features in a print. He measured various characteristics like ear length, width, antihelix length and width in 92 sets of prints each on soft surface and hard surface. in most of the cases he found increase in width with increase in force. He reported the variation in the range of milli meters of length of the ear and width of the anti helix. However he conducted the experiments on visible prints and did not discuss anything about latent prints whether the same can be concluded or not. Ingleby et al. (2000) conducted his experiments avoiding the differences in the variation of force, by considering the intensity medians as they remain more or less same even by the change of outlines.

Brucker et al.(2002)⁵ studied the anatomic and aesthetic differences between men and women as well as changes in the ear morphology with age. This study was done on a total of 123 volunteers(89 women age

between 19-65 years and 34 men age between 18-61 years). The median age of women was 42 years and the men was 35 considered for the study recording the age and sex of each. The methods used for the statistical analysis were t-test for age related changes, for sex related changes analysis of variance and pearson test for linear correlation were used. The sex related differences were found calculated, for measurement from lateral palpebral commissure to both helical root and insertion of lobule to be 4.6% longer than women. The height of the pinna is approximately 6.5% larger in men compared to women. the lobular height and width are nearly identical in both the sexes. The measurements for lobular height were 1.89 in men and 1.87 in women and for lobular width is 1.95 in men and 1.97 in women.

The lobular height increased with age in both men and women, but the lobular width decreased with age in women only. the angle between the axis of the pinna and angle of the lobule significantly varied among all the sample. The achievement was they found that the total ear size was larger in men than in women and the ear height and width are nearly identical. the ear height is increased in both men and women suggesting that the weight would not be the sole reason for the increase. The unavoidable result of aging is increase in the lobular height. Thus the purpose of aesthetic study was also fulfilled that the ear lobe shaping is done for younger look.

Meijerman et al. (2004) worked on thirty different latent prints, developed and transferred onto sheets to study their features. The studies landed them in some other conclusion that the effect of force is different in different individuals. The explanation for instance was given that the increase in force

decreased the dimensions of antihelix. Thus they concluded that the intra individual variation is the result of the combination of both the size of the ear and pressure distribution. Size of the ear Small ears (microtia), large ears (macrotia), undeveloped (anotia). Position of the placement of the ear low set ears refers to abnormal position of the ears posterior angulation of ears. Shape of the ear pinna such as pocket ear (cryptotia), scaphoid ear etc. Natural variations which are caused due to genetic reason such as development of cysts, skin tags etc.

In the ENT region 50% of the malformations affect the ear and mostly involve the right ear. The incidence of ear malformations is approximately 1 in 3800 newborns. Bozkır (2006) conducted the study which aimed to determine the mean values of the different morphometric measurements from both ears of the individual. These measurements were taken from 341 Turkish healthy young adults (150 women and 191 men) ages 18 to 25 years. The ear projection was measured as 17.10 mm in the young men and 16.61 mm in the young women. This was generally reported to be between 15-20 mm. The characteristics are similar in both except for ear height and ear width. They are some of those measurements which varied between males and female. As per the analysis these measurements were greater in male than in female.

The most interesting study was done by Meijer et al. in 2006 on variation of prints in monozygotic twins. He performed the experiment on 12 individuals (six pairs of monozygotic twins) whose ear prints show strong similarities between the pairs (reported). Both inter and intra individual

variations were investigated. The finding was that in most of the pairs the similarities were the inner margin of the superior helix. The dissimilarities were found in the posterior part of the helix, in the scapha region. all the prints collected were imprinted one over the other digitally and compared. the automation of prints were done to compare it with more accuracy and precision. A total of 260 male subjects between 1 and 80 years of age of north-west region of India were studied with regard to morphometry of the ear lobule by Anshu Sharma et al (2007).

The subjects were divided into 7 age groups and emphasised on the lobule characteristics like length , width, attachment, thickness etc. All the results statistically analyzed using Student's t-test to assess the significant changes in lobule with respect to age and side. It was observed that all the measurements increased with the age. The maximum length of the lobule increased appreciably between 6-15 years and 41-80 years. The breadth of the ear lobule increased up to the age of 15 years and it was almost static between the age of 16 and 40 years, and increased again from 41 years onwards. Breadth and thickness of ear lobule also showed statistically significant growth in some age groups.

These statistics were compared to other statistics of the world and concluded that the people (males) of north-west India have smaller lobules compared to other caucasians and japanese. The frequency of the attached (square) type of lobules was the maximum, followed by the free (pendulous) type and tapering lobules in the study. Verma. K et al.(2014) 14 studied different parameters in 100 men who aged between 20-60 of greater Noida, uttar

Pradesh, India like total ear length and length above tragus and below tragus, ear breadth, concha length, concha breadth, lobule height, lobule width. His most significant observation was the percentage of population with attached ear lobe (33.53) are less than the percentage of population with free ear lobe (66.46%). It was observed that in most of the parameters which were statistically significant when subjected to determination of identification, they showed a high percentage of differences between males. With the aim of determining the uniqueness of the individual using the morphology of the ear and variations in them, Verma. P 15 et. al in the year 2016 conducted a study on 80 individuals in the regions of north eastern and north western states of India.

Class characteristics like shape of the ear, attachment of lobule were studied among the population. In the category of the shape of the ear more prevalent is the oval shape and 65% of the sample showed attached ear lobes, which is in accordance with the study of sharma et al. and contradicts with that of Verma. P et. al. This might be because the study made by them were in different regions of India which had different ethnic and genetic backgrounds. Sforza¹⁶ et. al, studied the morphological differences between the normal individuals and individuals with down syndrome in comparison among the young adults ages between 12-45 years, identifying 13 landmarks on the ears of 28 subjects and 499 reference sample. the method used for analysis is ANOVA and the conclusion was that the landmarks varied significantly and dimensions are larger in case of the referred sample i. e normal individual when compared with the individuals with down syndrome. when studied according to age, all the landmarks increased with age. the

ratio of ear width to length is larger and the angle between the ear plane and the facial plane is larger in the subjects with down syndrome.

Discussion

The ear is one among them which was listed by the Charles Darwin as vestigial organs. later found that it helps in capturing the sound and maintaining balance. Some parts of the ear like the darwins tubercule can be found to be decended from the ancesters. Such peculiar characteristics help in the identification of the individual. The external part of ear can be found in the crime scenes like burglary, where the persons listens into the house before breaking in and in mass disasters to find out the individual whose the face was blown away etc.

The study of variations in the morphology of the ear helps in understand the importance of the ear in forensic purposes. The ear stretching to alter the whole appearance dates back to 3300 BCE, which was found by the dating the frozen mummy. The tribes like Massai of Kenya and Huaorani of amazon forests (In tribes of Africa and America) ear stretching was performed in various ways to alter their appearance as beauty was always at greater concern for human kind. Many studies were carried out in the direction to study variations which help as an identification tool in forensic purposes and to establish the differences with age and sex. The elongation process is speed in aged persons(above 60) and the elongation can be more seen in the lobule than in the whole ear length. The ear length and width remained almost same when compared in two sexes.

Due to the ornamentation of the lobule, elongation is seen more in female than in male. It is an established fact that due to elastic property and tensile strength of the skin, the variations in the length and breadth of the external ear is not easily observed. When the studies were done on the genetical variations like down syndrome, it clearly showed the demarcation between the normal individual and the person suffering from down syndrome. Thus ear prints can aid the investigation when there are vast differences in their morphology. The authors could not clearly show the distinguish while some had a vast differences to show in the age groups and sex related differences.

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