

EXPLORING THE IMPACT OF LONG-TERM OCCUPATIONAL EXPOSURE TO TANDOOR HEAT ON PALM PRINTS OF WORKERS IN JAMMU CITY

Shivani Ganjoo¹, Sahil Sharma², Rubal Lathwal³

¹Department of Forensic Science, Chandigarh University, PIN-140413

²Associate Professor, Department of Forensic Science, Chandigarh University, PIN-140413

³Research Scholar, Department of Forensic Science, Chandigarh University, PIN-140413

Email – shivaniGANJOO1999@gmail.com, sahilsharma.uiahs@cumail.in, rubal.r211@cumail.in

Abstract: Palm prints can be widely serve as a reliable method for identification of an individual as palm prints are used as physical evidence linking the victim, crime scene, and the suspect. Palm prints provide a broader area for the analysis of occupational marks similar to fingerprints. This study is regarding the impact of long-term occupational exposure to tandoor heat on the palms of workers conducted in Jammu City. The examination involves observing the specific characteristics associated with exposure to prolonged heat in the palm prints of tandoor workers. The characteristics include certain occupational marks such as, scars, burns, and depletion of ridges and creases. To observe the occupational marks 40 samples were obtained from the individuals who work with the tandoor fire against the control group of individuals consisting of 22 samples who work in the same profession but are not in direct contact with the heat. The aim and objective of this research is to determine whether heat exposure will make differences in patterns or features of palm prints, which are unique to each occupation or not and can be used during forensic investigations, biometrics, and legal procedures.

Keywords: Palm prints, Occupational marks, Investigation, Tandoor workers, Forensic evidence.

Introduction:

A palm print is a skin pattern made up of physical features like colour, texture and roughness. The general characteristics of palm prints are principal lines, wrinkles (secondary lines), and epidermal ridges which are unique to each individual (Kalthom Ahmad et al. n.d.). Palm print consists of two distinctive characteristics namely, the palmer friction ridges and the palmer flexion creases. Palmer friction ridges are ridged skin structures that do not contain oil glands but have sweat glands whereas gaps in the pattern of the epidermal ridges are called palmar flexion creases. The three main types of flexion ridges are distal transverse crease, proximal transverse crease, and radial transverse crease (fig. 1) (Jain and Feng 2009). These ridge patterns are different in person to person due to its individuality and can also provide information related to a specific individual's occupation through occupational marks. With the greater surface area for analysis, palm prints provide a broader range of occupational markings to identify distinctive characteristics related to an individual's occupation and tool handling (Kanchan et al. 2013). Occupational marks are useful forensic markers that help with the investigation process by providing information about an individual's work and their involvement in particular actions ^(Rajput1 and Manhas2 n.d.). Occupational marks are mostly found on the palms and fingers and could be found at the crime scene (Sharma 2021). These marks are attained from the continuous repetitive use of equipment linked with the work done by manual workers ^(Forbes n.d.; Rajput1 and Manhas2 n.d.). Occupational marks include calluses, blisters, scars, cuts, or unusual creases which represent the work activities of an individual in their different occupations (Joseph 1984). These are the few common categories of work related marks:

1. **Calluses:** Calluses are thicker, tough skin formed due to repetitive work. An occupation which requires a lot of physical work or tool handling can cause calluses which seem like rough and elevated regions on the skin. Mostly calluses are observed on areas like fingertips and the interdigital region of the palms.
2. **Blisters:** Blisters are fluid-filled pockets that can occur due to the exposure of skin to heat, flames, or due to friction. An occupation that requires handling hazardous materials, working in high temperatures, or coming into direct contact with hot objects. Blisters can be observed in fingerprints or palm prints. These can be circular or oval-shaped.
3. **Scars:** Permanent marks caused by wounds or injuries on the skin are called scars. An occupation that involves handling sharp tools or objects resulting in cuts or lacerations which may leave variations in patterns of palm prints.

The objective of this study was to explore the impact of heat on the palm prints of Tandoor workers and compare the findings with the group of individuals who were less affected with the heat conditions. By doing side by side comparison of the prints of tandoor workers with the non-tandoor workers, the research aims to identify specific differences attributable to the tandoor working environment.

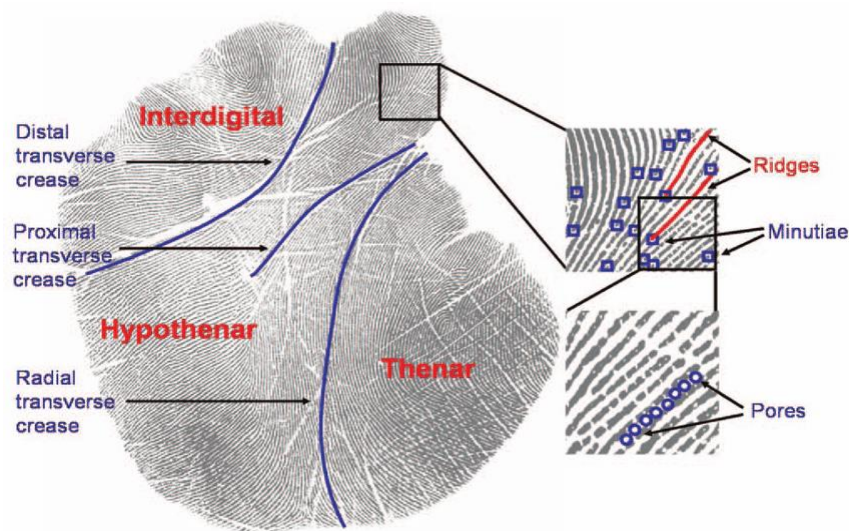


Fig 1: Three basic regions of a palm print showing major creases, ridges, minutiae, and pores.

Materials and Methodology:

- Black fingerprinting Ink
- Roller
- Glass plates
- Magnifying glass
- A4 sized sheet
- Pen
- Pencil
- Highlighting markers

The study was conducted in various neighborhoods within Jammu city including Subhash Nagar, Paloura, Rehari colony, Durga Nagar, and Muthi approximately 20 km in total, for the period of 3 months. The included participants were employed as Tandoor workers among side those in non-tandoor roles within the same workplace and unaffected by heat exposure.

Palm print samples were collected by using the traditional fingerprinting method. The prints were obtained firstly by washing the hands of the individuals to remove any dirt that may obscure the prints. Impressions were made on the plain A4 size sheet by simply placing both hands individually on the glass slab containing ink with specific attention to detail to ensure the production of clear and high-quality prints suitable for analysis. Detailed records were kept, including the work experience of an individual and also specific regions of the palm prints were highlighted by pencil where the marks were located. This study included the total data collected from 62 individuals collected from various occupational groups. Each occupational group, including Tandoor workers, consisted of a sample size of 40 individuals, while the comparison group consisted of 22 sample sizes of non-tandoor worker's palm prints. The age range of participant differed according to their respective occupations, as shown in the provided table below.

Category	Sample population	Age range
Tandoor workers	40	20-50 years
Control group	22	20-50 years
Total	62	20-50 years

Table 1- showing Sample population and Age range

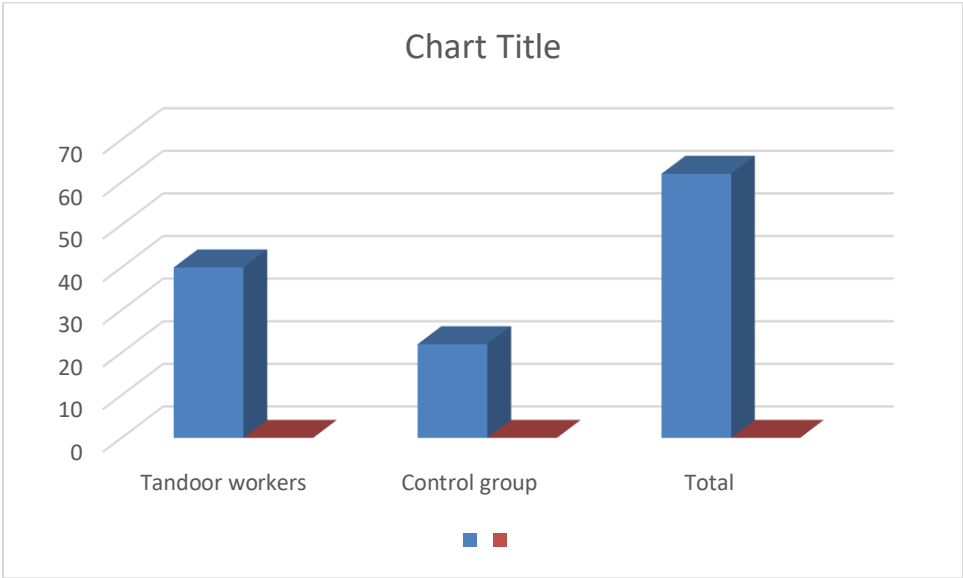


Fig.2. Chart illustrating the sample population of both categories

Result:

Observing occupational marks across different professions offers important understandings related to a person’s job or related work. In terms of Tandoor workers specific differences in the dermatoglyphics patterns of the palm can be observed. The region where fingers meet the palm known as interdigital region consisting of four digits, the carpal region above the wrist, and the hypothenar region of the palm exhibit oval-shaped as well as circular-shaped blister formation due to direct contact with heat as they put their hands inside the tandoor to make bread. Additionally, due to working for prolonged periods, they tend to develop calluses on digit ii and digit iii in the interdigital part of the palm observed in some cases. Another prominent indication is the existence of unusual cuts and scars located on the hypothenar region of the palm, resulting from the process of handling wood pieces for the tandoor fire. Furthermore, the ridges on the interdigital area of the palm may either become prominent or diminish depending upon the work experience. In addition, an increased quantity of lines as creases can be seen, along with atypical longitudinal creases extending from the interdigital to the carpal region contributing to the unique attributes present in the palm prints of tandoor workers.



Fig .3(a)



Fig .3(b)



Fig .3(c)



Fig .3(d)



Fig .3(e)



Fig .3(f)

Figures 3(a-f) -showing palm prints of tandoor workers.

Even though Non-tandoor workers also exhibit some characteristics similar to tandoor workers, as they work in the same profession. However, they show fewer characteristics than tandoor workers, as they are not in direct contact with the heat. Instead, they are responsible for tasks like cutting wood to make fuel for tandoor, and transferring it from one place to another, leading to the formation of unusual cuts and scars observed in the hypothenar region in the palms of those workers. Another observation includes the occurrence of increased creases in the interdigital region of the palm in certain cases, while in others, a lesser quantity is observed. Moreover, an additional observation involves less reduction of ridges in the middle area of the palm as compared to tandoor workers. This phenomenon is likely caused by the repetitive activities undertaken by non-tandoor workers, including the handling of wood and other materials ultimately resulting in the depletion and diminishing of ridge sin some cases depending upon the work experience.



Fig .4(a)



Fig .4(b)



Fig. 4(c)



Fig .4(d)



Fig .4(e)



Fig .4(f)

Figures 4 (a-f) showing palm prints of non-tandoor workers

All things considered, the analysis of the occupational marks observed in the prints of individual will serve as an important role related to forensic findings. The obtained marks can be useful for the forensic experts in focusing on potential areas, connecting individuals to particular professions, and providing insightful information about a person’s past employment as well as work related activities.

Table 2- showing the observation of Tandoor worker’s palm prints

Age group	Work experience	Observation
20 to 30 years	01-15 years	<ul style="list-style-type: none">- Diminished ridges from the middle area of the palm.- Lesser number of creases was observed in interdigital area.- Less number of blister formations.- Vertical creases were observed beneath the interdigital region.
31 to 40 years	03-25 years	<ul style="list-style-type: none">- Diminishment of ridges was observed in interdigital area.- Wide vertical creases from interdigital region extending to carpel region.- Oval-shaped and circular-shaped blister formation in the thenar area and carpel region.- Increased amount of creases were observed in the interdigital and thenar area at the base of the thumb.- Unusual scars in the hypothenar region of the palm print.
41 to 50 years	12-32 years	<ul style="list-style-type: none">- Calluses formation in the interdigital area of the palm print was mostly observed.- Higher number of creases in the thenar area of the palm.- Blister formation in the interdigital and hypothenar area.- Ridges are depleted in the middle area of the palm print.

Table 3- showing differences in the characteristics of palm prints of tandoor and non-tandoor workers

S No.	Characteristics	Tandoor Workers	Control Group
01	Ridges	- Reduction or depletion of ridges was observed from the middle area and from the interdigital area of the palm.	- A smaller number of depleted ridges were observed.
02	Creases	- Increased number of creases were observed in the interdigital area and thenar area at the base of thumb. - Longitudinal creases were observed from the interdigital Region to the carpal region of the palm.	- Lesser creases were observed in the interdigital area. - An increases amount of creases were observed on the whole palmer region.
03	Callus formation	-High Callosity was observed in the interdigital region of the palm mostly.	- Less callosity was observed. More creases are seen.
04	Blister formation	- Both circular and oval-shaped blisters are observed on the carpal region, hypothenar, and interdigital region of the palm	- Less blister formation was observed.
05	Scars and cuts	- Unusual scars were observed in the interdigital area as well as in the hypothenar area of the palm print.	-No scars were observed

Table 4- showing the comparison between the right and left hands of tandoor workers

Age Group	Right Hand	Left Hand
20-30 Years	- An increase in the number of creases was observed on the interdigital area and also on the thenar area. - Blister formation on digits II and III. - Oval-shaped blister formation in the thenar region.	-Unusual creases were observed in the interdigital region. - Circular-shaped blister formation on digit III. - Longitudinal creases were observed extending from digit I to the carpal region. - Diminished ridges were observed in the hypothenar region.
31-40 Years	- Scar formation around the carpal region. - Diminished ridges are observed in the thenar region. - A higher amount of creases were observed on the whole palmer region. - More than one oval-shaped blister formations were observed in the thenar region.	- An increased in number of creases were observed on the whole palmer region. - Oval-shaped blister formations were observed on the carpal region and thenar region.

41-50 Years	<ul style="list-style-type: none"> - Calluses formation was observed on the interdigital region. - An increases in number of creases were seen at the base of the thumb. - Oval-shaped blister formation on digit IV. - Scar formation was observed in the hypothenar region. - Diminished ridges were observed in the middle region. - More than one oval-shaped blisters formation were observed in the hypothenar region. 	<ul style="list-style-type: none"> - Calluses formation on digit I and III. - Unusual creases were observed in the thenar region. - Depletion or reduction of ridges was observed in the interdigital region.
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The findings of this research will give us important information about the presence and characteristics of work related marks in the samples of tandoor and non-tandoor workers. The examination will highlight the distinct characteristics that were seen frequently in tandoor workers as a result of their line of work. These characteristics include unusual scars and creases, calluses, and blister formation in certain areas of the palm prints due to prolonged exposure to heat.

Discussion:

The potential limitations of this research must be recognized. Occupational markings can also vary in terms of work environment, age structure, and differences in an individual's occupation. Moreover, even though the sample size is representative, it might not include all the people who work in particular occupations.

So, a total of 40 samples of palm print were collected from the tandoor workers. After the examination of the samples, it was observed that occupational making such as multiple oval-shaped blisters was observed mostly in the region of right palm print such as carpal region, interdigital region, and hypothenar region who were more than 45 years old having experience of work fewer than 32 years. Less callus formation were seen in samples of individual's having work experience of less than 15 years and high callosity was observed in the samples of workers having age more than 50 years and work experience of 32 years.

A total of 22 samples of palm print of non-tandoor workers were collected from the same workplace and having the same work environment but different activities mentioned in the observation and result. By comparing the characteristics of palm prints of both tandoor and non-tandoor workers it was observed that the workers who are in less contact with the tandoor heat show less number of occupational markings as compared to the tandoor workers.

It is evident that those workers who perform manual work daily with the tandoor tend to develop blisters, scars, cuts, and creases on their palms due to involvement in activities such as making fuel for the heat, placing the hands inside the tandoor for baking bread, etc causes scars, burns, and blisters on the area of palm like carpal region, hypothenar region mostly which are exposed to the direct heat of tandoor fire. Some of the workers both from the tandoor and non-tandoor categories get accidental cuts and marks due to handling wood cutting and transporting the fuel from one place to other causing cuts which eventually leave marks that were evident in the samples. These occupational markings on the palm prints of workers are a unique characteristic feature that will help forensic examiners identify and will aid in narrowing down the kind the work environment an individual is involved in as these marks will remain on the palms of tandoor works as they will continue their manual work.

Conclusion:

The result of this research concluded the importance of work- related marks as these marks are unique to each individual and can be used for forensic investigation and legal proceedings. By analyzing the unique and distinct features in the palm prints of tandoor workers it can be concluded that various marks tend to develop in the palms of workers due to the activities they are involved in. Both the tandoor workers and non-tandoor workers have occupational marks depending upon their work and the equipment or tools they use. Occupational markings can be seen such as blisters, scars, cuts, and callosity in the tandoor workers while an increased number of creases can be seen in the palm prints of non-tandoor workers. It was also seen that with an increase in work expertise or skill, there can be an increase in work- related marking such as creases and scars in the palm prints of tandoor as well as non-tandoor workers.

Moral consideration:

Moral standards were strictly followed in this research to protect the privacy and confidentiality of all individual. Detailed explanations about the research objectives and methodology were provided to each individual, ensuring they have a thorough understanding about the research. Before their participation, informed consent was obtained from all individuals involved in the study.

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