



Original Research

Identification and comparison of fingerprint damages among different occupations in Punjab, Pakistan for forensic casework

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Article Info.

Received: 08-09-2022
 Revised: 04-04-2023
 Accepted: 10-04-2023
 Online: 29-05-2023

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Keywords: Fingerprints, damages, identification, occupations, comparison

Abstract

Background: Fingerprints have minutiae details for identification and matching with reference. Fingerprint cannot alter by damaging the dermis by burning, abrasion or cut because they can re grow with the growing skin but in case, some occupations after minimum 10 years of working experience also have damaged fingerprints. This study's aim is to assess the profession-based damage to fingerprints for forensic science application. A veritable statistic on occupational fingerprint distortion will be estimated. **Method:** The study was suggestive and descriptive (Recognized within the 1 year of time period), register based research including 22 diverse occupations that continuously handling with different working things from last 10 years or more and get damaged their fingerprints. Any damage in secondary details of fingerprint with reference to occupation will be observed by using magnifying glass. Statistical techniques will be applied for further analysis. **Results:** This study was comprised by taking 102 patent samples of fingerprints including rolled, simultaneous, fingertips, palm prints, creases thenar, hypo thenar and inters digital from both hands of Pakistani population (Male and Female) of 22 different occupations. And identified various damaged percentages and also visible & clear ridges which have been counted for comparison with damaged ridges. **Conclusion:** Analysis of advance recognition marks by dermatitis changes in fingermarks with the experience of many years of working among various workers in Pakistan.



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Citation: Batool A, Fahad, Izzat. Identification and comparison of fingerprint damages among different occupations in Punjab, Pakistan for forensic casework. IJNMS. 2023; 2 (2): 21-26.

Introduction: In spite of the developments made in DNA profiling, fingerprints are still considered as the most widely established forms of forensic evidence used by law to certainly identify an individual [1]. As a profession peculiarity of forensic science is somehow equal to that of the whole judicial system it exists within some important terms of supremacy, strength, trustworthiness, and proficiency. The courts appointed those positions where all the forensic intelligence, expertise, enlightenment, and investigation are exhibit and assessed [2]. In the acknowledgement of fingerprints identification, that are the most widely used biometric feature for person identification and verification in the field of biometric identification. The appliance of minutiae based technique to verify the fingerprint image that captured at the crime scene [3]. Fingerprints give an impeccable means of personal recognition. It's very beneficial, because fingerprints are essential description for their having supersede other approaches of establishing the identities of criminals reluctant to admit previous arrests. Any other personal characteristics can change – but fingerprints do not till death. Taking and storing of the authentic evidences in the form of fingerprints, shoeprints, or other impressions is often risky and difficult [3]. Fingerprints are most valuable evidence for narrow down the investigation, and it creates a link between one crime scenes to another crime scene that related with a same person. Initially fingerprints formed during the time period of fetus growth an interaction occurred between the fetus and surroundings (uterus/placenta) that exerts continuous fine pressure on skin creates friction ridges. This pressure differences cause rare features to form, that at last develop fingerprints. Within the recognition of human recognizable proof, grinding edge skin is found as it were on specific parts of human body: the palms of the hands and the soles of the feet. In spite of the fact that their biological function is probably to extend frictional constrain between an object and the hand or the foot to seize things firmly or walk on the ground effectively, another utilization of the contact edge skin was found thousands of a long time back: human identification based on the designs of the grinding edges [4]. Fingerprints may damage or completely removed of some cancer patients after during chemotherapy. Industrial or factory workers often become cancer patients: including skin/lung cancer by handling or continuous inhaling of chemical reagents. In other aspect, Fingerprints of those patients erases by treating different kinds of chemical and drugs during chemotherapy [5]. There are moreover a few variables influencing victory rate of unique mark acknowledgment, the taking after conditions influence the unique finger impression acknowledgment frameworks: Cold finger, Dry/oily finger, Tall or moo mugginess, point of situation, Weight of situation, Area of finger on platen (ineffectively placed core), Cuts to unique mark, broken edges by manual action (development, planting, laboring and more..), That would always harm or influence fingerprints [6]. Fingerprints by features at three levels, in features level-1 included flow of ridges and pattern type, in features Level-2: end points of ridges and bifurcations, in features

level-3 included: ridge Details (pores) and incipient ridges [4]. Lee CK concluded his research in 2013 by observing different professions with different dermatitis changes such as Housewives, nurses, hair-dressers; workers (mesons, road makers, building construction labors) with repetitive handling with chemicals, cement, cutting oils, or abrasive are largely contained [7]. Patients with atopic eczema have a usual number of sweat pores on their fingertips, but the structure and features is disturbed in many patients [8].

In spite of broad investigate by Adishes in 2013, the expectation for specialists' remains movable, with opposite results on wellbeing and business. He diagnosed of alleged occupational skin disease should contain objective patch or prick testing and there are suggestions ought to be for wellness to work, such as modified business, misfortune of work or total alter of business [9]. Be that as it may, HFS has been detailed by Assi and his associates, as an uncommon side impact that may be initiated by paclitaxel [10]. Nonetheless, regarding occupational skin diseases, contact urticaria should be not ignored. Irritation to natural rubber latex is renowned; conversely, many other constituents found in cookery jobs and those jobs included adjacently contact with animals or vegetables can cause allergies [11]. Swelling, delicacy, thickness of calluses and rankles by HFS can result to skin peeling off, and ulceration [12]. There are many occupations which fully or minute damage the fingerprints by professional working since many years: welder, motor mechanics, housewife/maids, Drivers, electrician, farmers, beggars/junkman, carpenter, goldsmith, barber, gardener, loader/labors, industrial and factory workers, building construction labors, chef/cook, road makers labors, painters, butcher, cobblers, bricks Bhatta workers and Mesons. The major objective of current study is to delineate differences on their fingerprints after a long time period in a profession and continuous working. The goal of this project is to formation of methodology to assess profession-based damage to fingerprints for forensic science application and to establish veritable statistics on occupational fingerprint distortion. Advance recognition marks by dermatitis changes in fingermarks, with the experience of five to ten years of various workers in Pakistan. In future further prospects regarding forensics, this will help to for overcome the difficulties in investigations that relatable to identification of fingerprints damages.

Material and methods: Material

Material for whole research project were contained Plain white papers (Boxes placed for all prints), Hand wash, Tissues & Wipes, Gloves, Oil Paint (Blue and black) with almost equal consistency of Fingerprint Ink, Hand Roller (for proper spreading of ink), Rectangular Glass Slate, Camera, Plastic bottles, Lead pencil and FP Scale for sizing & Marks, HP scanner (HP Scanjet200), Computer system, Forensic optical comparator (F×8B), 5x and 10x Magnifier Glasses, LED Light magnifier glass 15x and Software included CSIpix4 matcher and comparator and statistics 8.1.

Method: Rolled prints: At first rolled fingerprints are made by rolling thumb from one nail edge to the other nail edge, it covered large surface (if fully rolled) fully rolled impressions not only allows reliable classification,

but it also gives more minutiae details for accurate identification and comparison. Rolled impressions should be in one movement and should not be reverse or double print, with only enough pressure to provide a clear print. Individual should not try to help the roll for reducing smudges. **Plain prints:** Then plain fingerprints have been taken of all participants, fingerprints impressions are made on paper simply by lightly pressing thumb, index, middle, ring and little finger of right hand and then same sequence was applied for left hand by following the above manner of sampling. Prints took by simply grasp the wrist with one hand and was pressed the fingers with other hand onto the sample paper. **Palm prints:** Then palm prints of right and then left hand have been taken by using any tubular shaped bottle and paper placed on bottle, then after applied ink on the rectangular shaped glass material and by using roller proper balance the ink on glass and gripped the palm of participant until fully covered by ink and confirmable placed on sample paper. **Fingertips:** After applying less quantity of ink on glass plate and then balancing by roller, only tips of all fingers of individual placed on glass one by one of both hands and then without exerting any pressure printed on sample paper. **Creases:** At the end creases including thenar, hypothenar and interdigital have been taken of right and left hand by carefully grip of participant hands and applied some more ink on glass plate Then closely pictures was captured of all prints one by one started from thumb of right hand and ended at little finger of left hand and same for palm prints and creases (thenar, hypothenar and interdigital) from sample papers in adequate sequence individually. Before identification of damages Rolled prints, plain prints, palm prints, fingertips and creases, all the samples have been scanned individually under 600 DPI resolutions with HP scanner scanjet200 for further comparison of secondary details.

Damage ridges Analysis: CSIpix4 software matcher with Computer system was used for detection and matching of two minutiae points i.e., bifurcation and ridge ending. The details were highlighted by red dots and boxes and thoroughly reviewed by magnify glass manually.

Some minutiae points were fabricated and altered the secondary details of fingerprints by software due to damages on fingerprints.

Normal and clear ridges Analysis: By using 5x and 10x magnifiers normal and clear visible ridges have been counted from the core till delta following the ridge pattern.

Reference sample which is also known as standard is normal fingerprint sample. Comparison of occupational damaged fingerprints has been taken with normal reference sample and secondary details with damaged minutiae points were observed. **Exclusion criteria:** Some abnormalities or missing any finger from both hands or missing arm/hand due to continuous serving in an occupation have been excluded from this research.

Statistical Analysis

All counted damages and normal ridges were concluded by calculating Chi-square value in applied statistics. Subsequently, all the data were added on statistix 8.1 (software) for further analysis. The overall data in Chi-

Square, degrees of freedom and P-values were analyzed by using following formulation:

$$\chi^2 = \frac{\sum (\text{Observed value} - \text{expected value})^2}{\text{Expected Value}}$$

a) **Significance data:** If P-value is less than 0.05 then the data will be significant.

c) **Non-significance data:** If P-value is not less than 0.05 then it will be non-significant.

All the same data of damaged and normal ridges (tables) were observed in graphs according to all fingerprint's values, percentages of damages and normality.

By following the inclusion criteria, strength of workers was selected from an occupation for overall identification by chi-square, P-value and degree of freedom. Significance of Normal and damaged fingerprints of both right and left hand analyzed such as if P-value > 0.05 then it will show non-significant results but if P-value < 0.05 then it will show significant consequences.

Results: All the prints (fingerprints and Palm prints) included damages observed and counting of visible ridges from the core to delta calculated manually. After computation study of secondary details like bifurcations and ridge ending findings, by using statistix 8.1 software the p-value and chi-square value of all occupation individually were observed and described with graphs, which show the different perimeters of scratched prints and non-Scratched prints (clearly visible ridges) of both hands.

For example, in table 1 shows Motor mechanic's Graphical representation shows Six motor mechanics are selected for overall identification by chi-square, P-value and degree of freedom. Normal and damaged fingerprints on both right- and left-hand show P-value > 0.05 and it is non-significant. Graphical representation shows fracturing is Maximum and creases are minimum damages observed in right hand. Fracturing is Maximum and creases are minimum damages observed in Left hand. From Right hand observed Maximum normal ridges count in ring finger/palm and minimum normal ridge count in little finger. From Left hand observed Maximum normal ridges count in middle finger/palm and minimum normal ridge count in index finger. By pie graph motor mechanic's damaged fingerprints shown Scars (24%) Creases (20%) Swelling (23%) and fracturing (33%) observed in right hand and Scars (21%) Creases (13%) Swelling (23%) and fracturing (33%) in left hand, while normal fingerprints shown of five fingers (thumb-14%, Index-14%, Middle-16%, Ring-16%, Little-11% and Palm-29%) in right hand and then (thumb-14%, Index-13%, Middle-20%, Ring-15%, Little-15% and Palm-23%) in left hand.

Discussion: The study considered which comprised 381 patients (373 ladies and 8 men). The middle age was 25years, 64.8% were disciples, and 35.2% were completely prepared beauticians. The predominance of atopic dermatitis was 36.0% and was essentially higher among disciples than among completely prepared beauticians (44.9% and 19.4%, individually). Of the patients, 48.3% had their dermatitis recognized as word related aggravation contact dermatitis & skin Ridges damages, 46.7% had their dermatitis recognized as word related unfavorably susceptible contact dermatitis or

combined unfavorably susceptible and aggravation contact dermatitis, and 5.0% were recognized as having word related contact urticarial [1]. This study (regards Occupational effects on fingerprints and skin also) was comprised by taking 102 patent samples of fingerprints including rolled, Plain, fingertips, palm prints, creases thenar, hypo thenar and inter digital from both hands of Pakistani population (Male and Female) of 22 various occupations (the minimum & maximum age criteria were below 30 & above 80). Damaged maximum percentages of overall fingerprints & palm prints of both hands were ~75% discretely (housewife, Loader, Farmer, junkman, painter).

Resistible and non-infectious hand and lower arm dermatoses are visit in day-by-day veterinary pharmaceutical. In this specific occupation there's a genuine effect of skin infection on the lives and careers of veterinarians. In their consider they clarify the distinctive word related dermatoses on hands and lower arms among veterinarians, using data collected in numerous dermatological patch-test master centers in Belgium and the Netherlands. Dermatoses were depicted in 12 cases. The non-infectious dermatoses in 46 cases can be classified as contact urticarial and as aggravation or unfavorably susceptible contact dermatitis. Samples were taken for this project that was regarding to occupations fingerprints distortions including rolled, Plain, fingertips, palm prints, creases thenar, hypo thenar and inter digital from both hands of Pakistani population (Male and Female) of 22 numerous occupations in those occupations dermatology is minor priority as compared to the epidermis & dermis damages which altered the fingerprints of those workers. Tall rates of skin illnesses and higher non-melanoma skin cancer rates have been detailed in ranchers. Self-report of dermatitis and skin cancer was among the data collected from 1947 California cultivate administrators. The larger part of the agriculturists developed natural products, nuts, or other field crops. Dermatitis was detailed by 8.9% of men and 15.8% of ladies amid the previous 12 months of working. There was essentially less announcing of skin cancer among field ranchers when compared to others. He concluded that more in-depth ponders are required to induce data on the part of agrochemicals as hazard variables for dermatitis, skin breaking and skin cancer [12].

As selected all those major occupations, farmers were also selected who have much more work experience as compared to other workers. With the results formation, from ~47% – 70% of their right hands and 45% to ~72% left hands of farmers got damaged due to continue handling of fertilizers and also during season cultivation of wheat and rice in fields. The point of thinking is to assess the predominance of hand skin inflammation and contact hypersensitivity in car mechanics and may come about into twisting of typical fingerprints of workers. Researcher considered the relationship between atopic history and hand skin inflammation; He moreover characterized the allergens particular for this exchange. He found the hand dermatitis impacts at slightest 10% of people of working age in a year. Damaged perimeters from ~45% to ~67% of right hand and from 40% to ~70% for left hands of motor mechanics have been

concluded and also was checked the consequences significance of motor mechanics with the handling of heavy machines & engines of vehicles as compared to other occupations working criteria. The aim of the study is to identify those secondary details which are missing or improper visible (distorted) and also counted visible ridges which are not distorted or fractured. With the influence of Occupation, it is concluded that the percentages of undamaged and damaged level of fingerprints among various Labor like Occupational workers.

Conclusion: This study concludes that to delineate differences on fingerprints after a long time period by many professions or by continuous working. Analysis of profession-based damages in fingerprints which might be applicable in forensic investigations. Population study by establish veritable statistics on occupational fingerprint distortion. In future, this study will help to overcome the difficulties for fast forensic investigations that relatable to identification of fingerprints or their damages and to narrow down the crime scene puzzle.

Ethical approval: All studies were approved by ethical committee.

Consent: All study subjects and participants partake after informed consent.

Author's contributions

Dr. Muhammad Saqib Shahzad who suggests me the techniques for sampling of whole project and made the draft of research article. Dr. Qurban helped me to evaluate the data of all occupations and how to made all statistical analysis.

Acknowledgment: My deepest gratitude is to **Dr. M Arslan, Director, Institute of Molecular Biology and Biotechnology** for his encouragement and guidance during my study tenure and my Supervisor **Dr. Arif Malik** who always led me to learn a lot. I have worked on my research project under the supervision of Fingerprint expert **Mr. Waheed Anwar** in Latent Fingerprint section, National Forensic Science Agency Islamabad (**NFSA**). I am very grateful to my research fellows who knowingly and unknowingly led me to an understanding of some of the more subtle challenges to my ability to thrive. It is also written in honor of my university.

Funding: No Funding.

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Table 1. Statistical analysis in Motor mechanics

Motor mechanics	Sample ID	Normal Print (Ridges)	Damaged Print (Ridges)
Right Hand	FP8/34 To FP8/39	Overall Chi-Square 10.36 P-Value 0.4092 Degrees of Freedom 10	Overall Chi-Square 7.14 P-Value 0.9538 Degrees of Freedom 15
Left Hand	FP8/34 To FP8/39	Overall Chi-Square 23.25 P-Value 0.3204 Degrees of Freedom 10	Overall Chi-Square 14.74 P-Value 0.4705 Degrees of Freedom 15

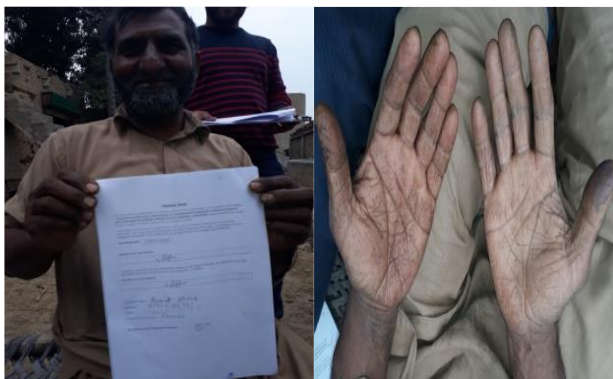


Fig. 1. (a) Mugshot of participant with Consent Form. (b) Picture of Right & Left hand of participant before taking sample.



Fig. 3. Ridges counting by 5x and 10x magnifiers.

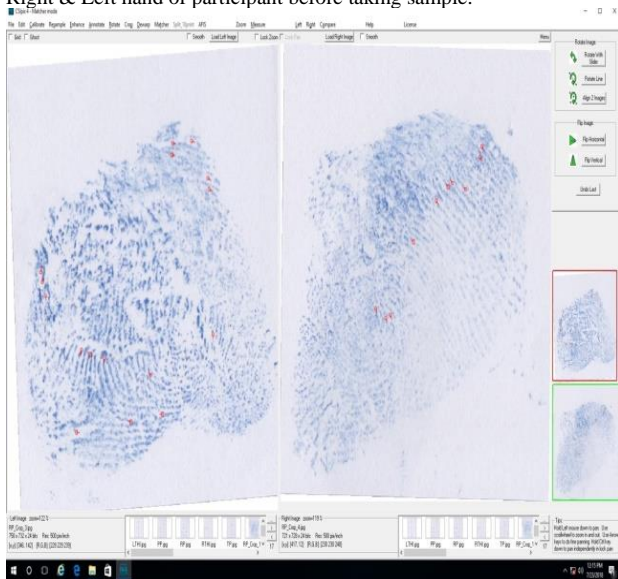


Fig. 2. Bifurcation and ridge ending detection on thumb print of Right and left hand.

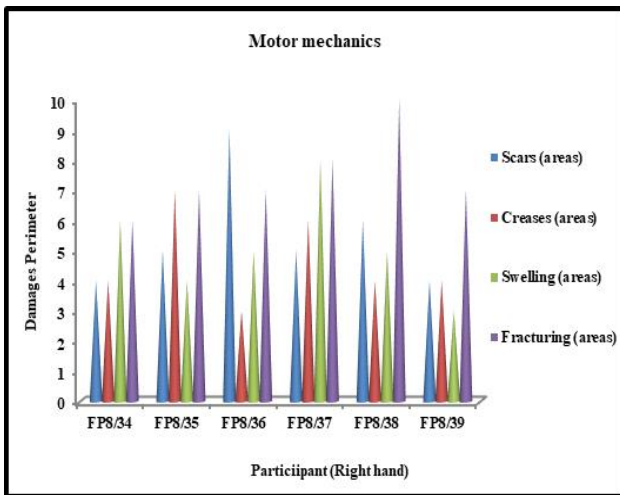


Fig. 4. Graphical representations of Damage Prints (Right) in Motor mechanics.

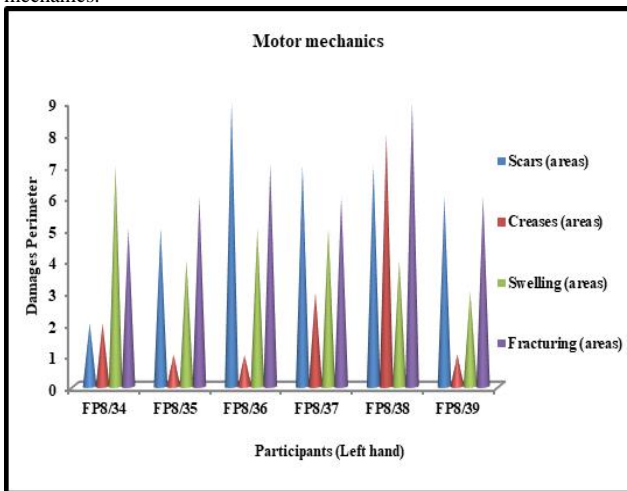


Fig. 5. Graphical representations of Damage Prints (Left) in Motor mechanics.

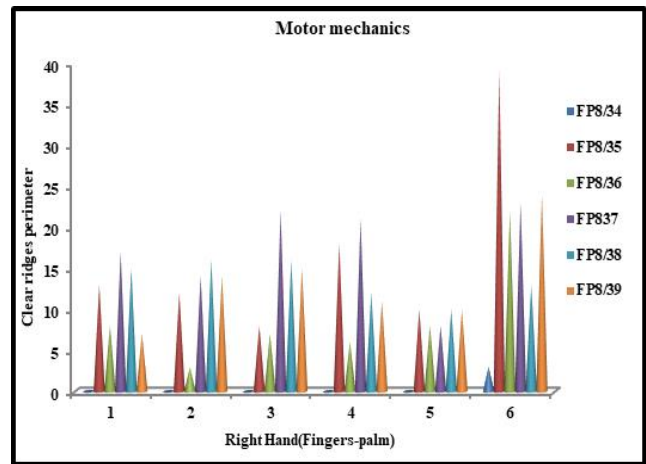


Fig. 6. Graphical representations of Normal Prints (Left) in Motor mechanics (1=thumb, 2=index, 3=middle, 4=Ring, 5=Little and 6=Palm).

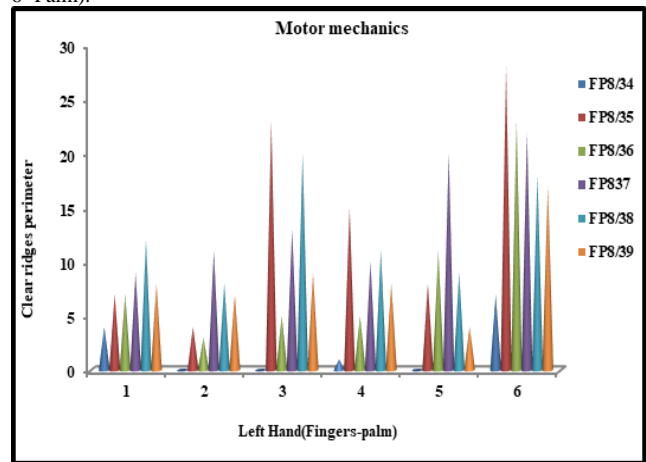


Fig. 7. Graphical representations of Normal Prints (Left) in Motor mechanics (1=thumb, 2=index, 3=middle, 4=Ring, 5=Little and 6=Palm).

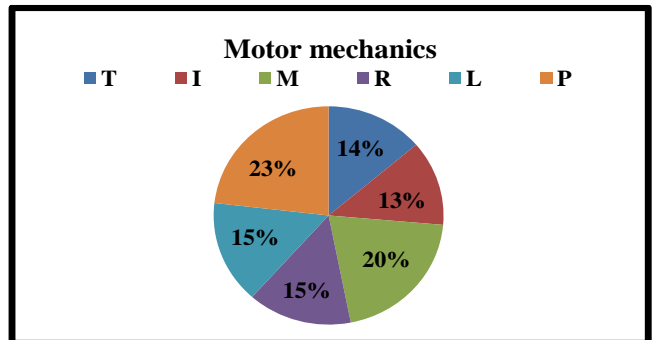
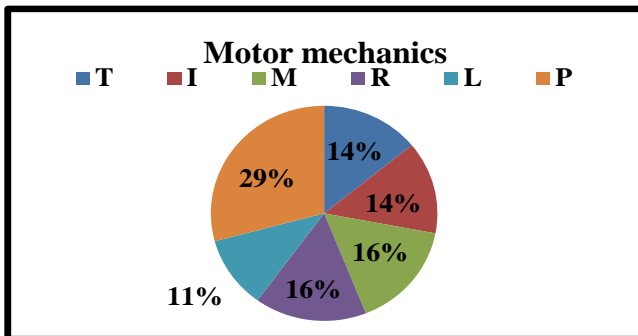


Fig. 8. Ridge count percentages by Pie Graph representation Right and left hand (T=thumb, I=index, M=middle, R=ring, L=little and P=Palm).

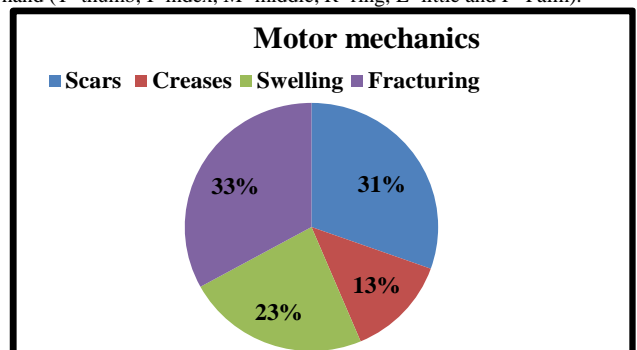
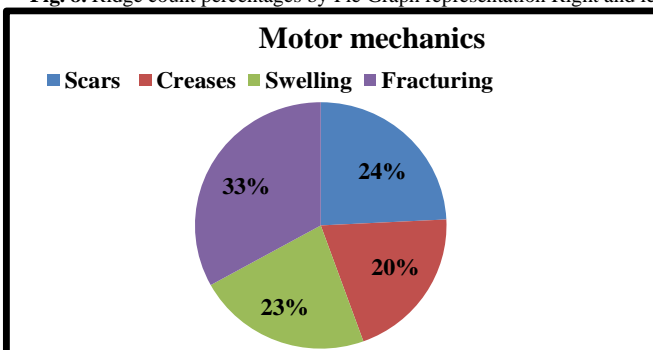


Fig. 9. Damaged ridges percentages by Pie Graph representation of Right and Left hand