

## Estimation of Age of Abrasion by Gross Examination at Autopsy: A Cross-Sectional Study

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### Abstract

**Background:** One of the most important aspects of medicolegal injury examination is the determination of the age of the injury. This study of wound dating from the gross examination of abrasion is being conducted to look into the accuracy of dating the wounds by the age determined by gross changes with that of the time of infliction of injury.

**Methods:** In this cross-sectional study, 102 dead bodies brought for medicolegal autopsy, having a well demarcated abrasion and a known time of infliction of injury were selected. Based on the duration of infliction, abrasions were categorized into 13 groups. Gross changes that follow blunt trauma were studied and correlated to the time frame of the occurrence of abrasion.

**Conclusion:** A significant relationship between the age and color of abrasion ( $\chi^2_{72}=387.59, P<0.001$ ) was observed. On gross examination, bright red color was seen in abrasions aged <24 hours; reddish scabbed abrasion from 10 to 32 hours; brownish scabbed abrasion from 16.5 to 72.17 hours; dark brown scabbed abrasion from 35.5 to 157 hours; and black scabbed abrasion was observed only after 72 hours (3 days). Abrasions with scab fallen at a margin were seen from 7th to 14th days, and scabs completely falling off exposing hypopigmented skin were observed in abrasions aged >336 hours (>2 weeks).

**Key Words:** Abrasion; Age of abrasions; Autopsy; Gross change.

### Introduction

The dating of injuries has long been a cause of discord among researchers. In the current time the role of doctors has become crucial for the examination,

treatment, and certification of injuries. With factors such as self-inflicted, fabricated, and artificial injuries, the role of the forensic pathologist in the evaluation of injuries has been a significant cog in the wheel of

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the medicolegal system. Whenever an injury needs to be evaluated and certified for medicolegal purposes, a doctor must consider various aspects of the wound, such as its type, size, pattern, and the type of weapon used to inflict the said injury. At autopsy, a forensic pathologist also must evaluate whether the wound is antemortem or postmortem. One of the most important aspects of injury examination is the determination of the age of the injury. Significant medical and legal ramifications could result from their interpretation, such as inclusion or exclusion of a suspect as a criminal offender. [1]

In forensic autopsy practice, blunt impact injuries are frequently observed, and proper interpretation of wounds is crucial for reliable medical testimony. [2] Abrasion is one of the most common blunt traumas observed [3] and it is the most important tool for determining the age of the injury.

In India, as well as in many other developing countries, injuries are usually dated by naked eye examination. [4] Color changes in abrasion are frequently used for age estimation of injury. However, some authors consider it as an uncertain and variable method for dating the wound due to observer bias. [4,5] However, the naked eye examination during autopsy is the only tool to determine the age of abrasion, when there is no reliable history of time of infliction. Hence, this study was conducted to date abrasion from the gross changes that follow blunt trauma.

### Material & Methods

This cross-sectional study was conducted in the Department of Forensic Medicine and Toxicology, Shyam Shah Medical College, Rewa, (M.P.) from 1st January 2021 to 30th June 2022, after obtaining ethical clearance from the Institutional Ethics Committee (IEC).

The study population was dead bodies brought by the police for medicolegal autopsy. Dead bodies having a well-demarcated abrasion and a known time of infliction were included. Dead bodies with infected abrasions and in the state of decomposition were excluded from the study.

According to the case selection criteria, 102 cases were selected. A written informed consent was obtained. Information regarding the time of injury,

time of death, hospitalization, and associated comorbidity were noted. Based on the age of infliction, abrasions were categorized under 13 different time intervals i.e.  $\leq 12$  hours, 13 to 24 hours, 25 to 36 hours, 37 to 48 hours, 49 to 60 hours, 61 to 72 hours, 73 to 84 hours, 85 to 96 hours, 97 to 120 hours (5th day), 121 to 144 hours (6th day), 145 to 168 hours (7th day), 169 to 336 hours (8-14 days), and more than 336 hours (2 weeks). Relevant details of the abrasion such as site, size, and color were noted.

Data was analyzed using SPSS version 20.0 software.  $P < 0.05$  was considered significant. Descriptive data were expressed as frequency. For the age group of abrasions (quantitative data), mean and SD were calculated. Pearson's chi-square test of independence was used to compare the gross changes in abrasion with the age of infliction of abrasion.

### Results and Discussion

In this cross-sectional study sample size was 102 cases. The sample size in our study was higher compared to other studies [4-10] except the study conducted by Sandhu et al. (N=150). [11]

In this study, of 102 cases, 84 (82.35%) were male and 18 (17.65%) were female. Our study showed a male preponderance (M:F::4.67:1), similar to other researches. [4,5,7-11] The observed male preponderance may mainly be attributed to the fact that men are more prone to injuries since they are more involved in outdoor activities such as driving vehicles, labor workers, etc. Sharma et al. [6] in their study, did not distribute the cases by gender.

The age range of the study subjects in this study was from 4 to 80 years. The age range of subjects in other research was from 1 year to more than 60 years, [4,7,9-11] except in the study by Saxena et al. [8] and Siddiqui et al., [5] where the subjects of age groups of 18 to 60 years and 20 to 60 years, respectively, were included.

We observed the abrasions were most common in the age group 31 to 40 years (25/102, 24.51%), a similar finding was reported by one researcher. [7] The second most common age group sustaining abrasion was 21 to 30 years (24/102, 23.53%). The reason for the age group of 21 to 40 years being more prone to injuries could be that this age group forms the major

workforce and is susceptible to injuries due to road traffic accidents, falls, assaults, etc.

We found road traffic accidents (88/102, 86.27%) to be the most common cause of abrasion, a similar observation was reported in one study. [4] Fall (13/102, 12.75%) were the second most common cause of infliction of abrasion.

Of 102 cases, 59 (57.84%) cases had a history of hospitalization and 43 (42.16%) cases were non-hospitalized.

In our study, bright red abrasions were the most common (54/102, 52.94%) and reddish scabbed abrasions were the least common (3/102, 2.94%) observations.

We observed, the majority (50/54, 92.59%) of bright red abrasions were  $\leq 12$  hours old and 4 (7.41%) were 13-24 hours old. Our observations were in agreement with various textbooks and studies in which bright red abrasion was observed within the first 12 hours. [8,9,12-16] We observed the bright red abrasion earliest at 0.02 hours and the latest up to 20 hours post-infliction. Research reported bright red abrasions as early as 10 minutes, and up to 5 hours [4,5,10] to 7 hours [6] old abrasions. In contrast, one researcher reported that most cases on the first day were dark red instead of bright red. [7]

We found 3 abrasions with reddish scab, of which one (33.33%) was  $\leq 12$  hours old and 2 (66.67%) were 25-36 hours old. Reddish scabbed abrasion was observed as early as 10 hours and latest up to 32 hours. Various textbooks and studies found red scabs to form on abrasions from 12 to 24 hours. [8-10,12-16] One study reported that reddish scab formation in abrasions was observed mostly between 4 to 24 hours and seen latest up to 24 to 72 hours old abrasions. [4] A few authors observed reddish scab formation as early as 7 to 8 hours [6,17] and latest up to 24 hours. [17] We could not compare or draw any meaningful conclusion from our observations in respect to the formation of the reddish scab over abrasions with other studies and texts since the number of cases in this study group is too small (3/102).

Among 11 cases with brownish scabbed abrasion, 2 (18.18%) were 12-24 hours old, 4 (36.36%) were 25-36 hours old, 2 (18.18%) were 37-48 hours old, and

one abrasion (9.09%) was observed to be in each age group of 49-60 hours, 61-72 hours and 73-84 hours. Brownish scabbed abrasions were observed from 16.5 to 72.17 hours post-infliction. Standard textbooks and research differ at the age of the appearance of brownish scab in abrasions. Textbooks quote brownish-red scabs to be present in 24-48 hours old abrasions [14] to 48-72 hours abrasions. [12,13,15] However, researchers reported the abrasion to be covered with brown scab in 24 to 72 hours after injury. [4,5,8,10,17] One study [6] reported brownish scab as early as 19 hours old abrasions, which is close to the observation made by us i.e. 16.5 hours. In contrast to other studies, Kumar et al. [7] observed that on the 3rd day, the majority of injuries were dark red instead of brownish.

In our study, dark brown scab was observed in 13 abrasions. Among these, one (7.69%) abrasion was observed in each age group of 25-36 hours, and 61-72 hours old; 2 (15.38%) cases were 73-84 hours old; 4 (30.76%) were 85-96 hours old; 3 (23.08%) were 97-120 hours old; one (7.69%) case was observed to be 121-144 hours old; and one (7.69%) case was 145-168 hours old. The maximum number of dark brown scabbed abrasions (n=10) were observed between 73 hours to 144 hours. The earliest dark brown scab was observed at 35.5 hours and the latest at 157 hours. Our findings are supported by various textbooks that quote dark brown to form over abrasions in 2 to 7 days. [12-16] One study reported an earlier appearance, at 27 hours, of dark brown scab in abrasion. [6] Other authors observed dark brown scab earliest in 3 to 4 days, [8,17] and latest up to 5 to 7 days [8,9] old abrasions. These observations are different but are within the purview of our observations. On the contrary, Kumar et al. [7] found a dark red scab instead of a dark brownish scab on the 5th day. A few studies [4,5,10] observed dark brown scab in the majority of cases between 4-6 days, however, any meaningful conclusion could not be drawn by their study due to the less number of study samples.

We found, 8 abrasions with black scab, of which, one (12.5%) abrasion was 73-84 hours old, 2 (25%) were 97-120 hours old, 2 (25%) were 121-144 hours old, and 3 (37.5%) were 145-168 hours old. After 96 hours (4 days), the majority (7/8, 87.5%) of abrasion showed black scab. The earliest black scab was observed at 73 hours and the latest at 165.67 hours. Similar observations were reported in one study where black

scabbed abrasions were seen from 3 days to 7 days. [8] Textbooks differ significantly in the formation of black scabs over abrasions that vary from 4-7 days, 6-8 days [17] to 7-14 days [4,5,9,10] post-infliction. Two of the researchers [4,5] observed that the black scab was seen only after 5 days, and was seen at 21 days in a deceased who had no comorbidity, and was in the leg (less vascular area). Presence of multiple comorbidity delays formation of black scab which was observed on 35th day. [4]

In this study, 8 abrasions showed scab fallen off at the margin. Among these, one (12.5%) was 145-168 hours (7th day) old and the majority i.e. 7 (87.5%) were 169-336 hours (8-14 days) old. Scab falling at the margin was observed earliest at 145.83 hours and latest up to 333.33 hours. Textbook, and research support our observation. [4-6,10,17] They also observed that falling off of scab was delayed in healthy individuals where the injury was located in the lower extremity (knee). In cases experiencing septicemia, there was a significant delay in the fall of scab observed up to 45 days. In contrast, an earlier

separation of scab at the margin was noted by some authors. [8,14] They quoted shrinkage and falling off of scab by as early as 5 days and latest up to 7 to 8 days after sustaining abrasion.

We found 5 abrasions with scab fallen off completely exposing hypopigmented skin. All were more than 336 hours old. The complete falling off of scab was observed earliest at 344.5 hours and the latest at 1203.42 hours. A few researchers reported similar observations. [4,5,10] In non-agreement with our observations, various textbooks quote that scab falls off completely in more than 7 days old abrasions. [12,13,15,16] Bigger scabs take a few days more to fall off. [17]

In this study, the relationship between age group of infliction and color of abrasion was assessed and found to be statistically significant ( $\chi^2_{72}=387.59$ ,  $P<0.001$ ). A similar statistical significant relationship between the age and color of abrasion was reported by Vinay J et al. ( $\chi^2_{36}=2.32$ ,  $P<0.001$ ). [4]

**Table 1. Distribution of cases by Age Group and Gender**

Age Group of cases (years)	No. of Cases		
	Female (n)	Male (n)	Total N (N%)
1-10	3	5	8 (7.84%)
11-20	1	11	12 (11.76%)
21-30	2	22	24 (23.53%)
31-40	4	21	25 (24.51%)
41-50	4	12	16 (15.69%)
51-60	2	6	8 (7.84%)
61-70	1	5	6 (5.88%)
71-80	1	2	3 (2.94%)
Total	18 (17.65%)	84 (82.35%)	102 (100%)

**Table 2. Distribution of cases by Age of Abrasion and Color of Abrasion**

Age of Abrasion	No. of cases (n)	Age of Abrasion Mean (SD) (hours)	Color of Abrasion	No. of cases (n)
≤12 h	51	3.36 (2.91)	Bright red	50
			Reddish scab	1
13 to 24 h	6	16.82 (3.22)	Bright red	4
			Brownish scab	2
25 to 36 h	7	31.06 (3.54)	Reddish scab	2
			Brownish scab	4
			Dark brown scab	1

Continue....

37 to 48 h	2	38.67 (3.06)	Brownish scab	2
49 to 60 h	1	59.5 (0)	Brownish scab	1
61 to 72 h	2	65.25 (6.01)	Brownish scab	1
			Dark brown scab	1
73 to 84 h	4	75.25 (5.51)	Brownish scab	1
			Dark brown scab	2
			Black scab	1
85 to 96 h	4	89.53 (1.93)	Dark brown scab	4
97 to 120 h (5th day)	5	105.57 (6)	Dark brown scab	3
			Black scab	2
121 to 144 h (6th day)	3	126.86 (7.78)	Dark brown scab	1
			Black scab	2
145 to 168 h (7th day)	5	156.09 (9.55)	Dark brown scab	1
			Black scab	3
			Scab fallen off at margin	1
169 to 336 h (8th to 14th day)	7	240.33 (70.98)	Scab fallen off at margin	7
>336 h (>2 weeks)	5	664.88 (345.89)	Scab completely fallen off exposing hypopigmented skin	5
Total	102	79.48 (166.06)		102

### Conclusion

We found:

1. The most common age group that sustained abrasion (49/102, 48.04%) was 21-40 years.
2. Male preponderance (M:F::4.67:1) across all age groups.
3. Accident to be the most common cause of infliction of abrasion (86.27%).
4. On gross examination, bright red color was seen in abrasions aged <24 hours; reddish scabbed abrasion from 10 to 32 hours; brownish scabbed abrasion from 16.5 to 72.17 hours; dark brown scabbed abrasion from 35.5 to 157 hours; and black scabbed abrasion was observed only after 72 hours (3 days). Abrasions with scab fallen at a margin were seen from 7th to 14th days, and scabs completely falling off exposing hypopigmented skin were observed in abrasions aged >336 hours (>2 weeks).
5. A statistically significant relationship ( $\chi^2_{72}=387.59$ ,  $P<0.001$ ) between age of

abrasion and gross changes in abrasion observed.

### Limitation

In individuals with dark brown complexion, the early color changes are difficult to appreciate clearly, and more so, this type of naked-eye observation is subjective. Observations were made by a single observer; however, due to the subjective nature of interpretation of color inter-observer bias may arise. Because of the random sampling of the cases, the majority of samples were from cases brought within 6 hours of infliction of abrasion.

### Recommendation

In Indian scenario, for dating of injuries, we rely on naked eye examination (subjective) of gross changes, which are owing to limitations and confounding factors as discussed, gives only a rough estimate regarding the age; thus, subjecting the samples to histopathology examination for corroboration is recommended, particularly in sensitive cases that

demand more accurate determination of the age of the injury. In cases with multiple injuries over different sites, the healing process may vary because of various factors such as type, size, location of the wound, vascular supply, infection, movements, nosocomial infections, ionizing radiation, U.V. light, circulatory status, metabolic status, and hormones, and thus, opining the age of the injury would be difficult and would not correlate accurately with the time of infliction of the injury as alleged by the police or relatives. Hence, the autopsy surgeons are well advised to exercise caution while opining the age of abrasion solely based on naked eye examination (subjective) of gross changes.

**Ethical Approval:** Prior ethical clearance from the Institutional Ethics Committee was obtained for the research.

**Conflict of Interest:** None.

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