DOI Number: 10.5958/0974-1283.2019.00001.X

An Evaluation of Colour Change in Abrasion and its Correlation to Time: A Cross-Sectional Study From a Tertiary Care Centre

Anil Mangeshkar[1], P S Varghese[2]

[1]Assistant Professor in Department of Forensic Medicine at Government Medical College Khandwa Madhya Pradesh; [2]Prof. and HOD, St. Johns Medical College

ABSTRACT

Ageing of abrasions among Indian population compared to the West has a wide range of variations. There is not much reported work from India as to the healing pattern and morphological appearance of abrasions in correlation to time since injury. A cross sectional study of patients randomly selected for a naked eye examination of the abrasions compared with standard colour-charts. Comparison was then made between the standard literature and the data gathered to ascertain the applicability of the Western findings on Indian population. It is observed that fresh injuries and injuries which are more than 7 days old have a high percentage of agreement with the available literature. The Spearman's rho showed positive correlation between time since injury and colour of abrasion to be 0.902 (p value<0.001). However those abrasions which age between 12 hours to 7 days have a lesser percentage agreement with the available literature in the standard text. The Spearman's test of correlation for abrasions between 12 hours-7 days, after excluding extreme intervals which correlated completely with literature, still showed high correlation (Correlation Coefficient- 0.749, p value <0.001).

In patients with head injury the percentage agreement falls to 50 percent, conveying a delay in healing of abrasions. Subjects with diabetes in this study did not differ from other subjects in terms of healing statistically, possibly due to small sub-sample size.

Keywords: *Abrassion, Colour change, Time since injury*

INTRODUCTION

Dating of an injury in both living and dead is an important medico-legal issue in the field of crime investigation to fix the liability and to correlate with the crime scene. A doctor is required to date injuries specifically and individually while preparing an injury report or while performing a post mortem examination.[1]

It is essential to age the injuries on the body of victim or the accused himself as it aids in proving or disproving the guilt or innocence of a person charged with criminal act, for its appearance may or may not correspond to the time when it is alleged that all to have been inflicted according to the prosecution theory. In Indian scenario, usually, we adopt the 'naked eye examination' method to date an injury.[2]

There is obvious incongruity existing in the standard textbooks, sufficient enough to pose difficulty for dating of mechanical and thermal injuries.[1] An abrasion is bright red between 12-24 hrs and the scab becomes reddish brown in 2-3 days [3] is documented by one author, but reddish brown scab within 12-24 hrs and brownish scabbed abrasion in 24-48 hours by another author. [4]An eminent author [5] claims that it is impossible to comment on the age of a bruise less than 24 hours. Another reported bluish discoloration of bruises not later than 18 hours.[6]A bruise looks bluish black, brown or livid red by 2 to 3 days and become greenish from 5th to 6th day was the observation of a distinguished Indian author.[7]

Most of the literature available in text books regarding ageing of injuries has been borrowed from western literature

Corresponding Author:
Dr Anil Mangeshkar
890 Nanda Nagar Stadium Ground Colony
Indore-452011, Madhya Pradesh

and very less work has been done on Indian population. Our Study is an attempt to study the morphological changes in the most common injuries i.e. abrasions and compare the same with the standard text books.

MATERIAL AND METHOD

A cross-sectional observational study of patients was conducted and data was collected from 100 patients who presented to the hospital with abrasions. Detailed history including time of injury, mechanism of injury, history concerned with head injury, preexisting diabetes, history of previous or chronic medical illness were documented.

Inclusion Criteria:

1. Data collected from trauma patients visiting the hospital
2. Trauma as a result of road traffic accident, fall from height or self fall.

Exclusion Criteria:

1. A known case of bleeding disorders, connective tissue disorders, skin disorders.
2. Patients who have used pigmented ointments prior to hospital visit.
3. Abrasions with super-added infection

The study looks at the pattern of colour change in abrasion over a specific time line. The naked eye appearance of abrasions was matched with a standard colour chart for colour changes over a period of time and the observations obtained were compared with the standard literature

Using standard colour-charts wounds were inspected in proper illumination and were compared with the colour chart to assign a colour code. For this purpose Hex colour codes are used, HEX colour codes are HTML colours defined by using a hexadecimal notation (HEX) for the combination of Red, Green, and Blue colour values (RGB). The lowest value that can be given to one of the light sources is 0 (in HEX: 00). The highest value is 255 (in HEX: FF). HEX values are specified as 3 pairs of two-digit numbers, starting with a # sign.[8]

Minimum of 94 subjects were required for adequate power of the study as calculated by pre-study analyses of past studies. A sample size of 100 was arrived such that it will ensure 80% power to test the hypothesis that colour change occurring one day after injury in 85 % of the wounds in comparison to past studies which state colour change in 74.33% with 5% alpha error.[9]

Descriptive statistics were applied to present the distribution in gender, subjects' age and frequency of abrasions in various time intervals. To establish the relationship between occurrence of abrasions and time elapsed at evaluation by the examiner Spearman's Correlation test was used. The correlation test was re-administered excluding one group at either end of spectrum to establish robust evidence.

FINDINGS

On a total of 100 patients in the study ninety percent were males, only ten percent of the patients were females.

Table 1: Gender Distribution

Gender	Total (n = 100)
Male	90 (90%)
Female	10 (10%)

Majority of patients were from age group of 16-30

Table2: Age Intervals

Age (Yrs)	Frequency (n = 100)
1-15	04
16-30	48
31-45	28
46-60	13
61-75	07

On a total of 18 fresh abrasions observed 16 appeared bright red in colour, which amounts to 88.9 percent. Hence the percentage agreement between fresh abrasion and bright red colour appearance of wound is 88.9.

Table 3: Percentage agreement with existing literature between fresh abrasion and bright red colour appearance of abrasions

	Bright red colouration (Obresved in literature)	Frequency n = 18	Percentage
Fresh Abrasion	Correlating	16	88.9
	Not Correlating	02	11.1

On a total of 29 abrasions observed between 12 to 24 hours, 16 abrasions were covered with red colored scab, which amounts to 55.2 percent. Hence the percentage agreement between 12-24 hours old abrasion and red colour appearance of wound scab is 55.2.

Table 4: Percentage agreement with existing literature between 12-24 hours old abrasion and red colour appearance of wound scab

	Red colouration (Observed in literature)	Frequency n = 29	Percentage
Abrasion 12-24 hours old	Correlating	16	55.2
	Not Correlating	13	44.8

On a total of 24 abrasions observed between 2 to 3 days, 9 abrasions were covered with reddish brown scab, which amounts to 37.5 percent. Hence the percentage agreement between 2-3 days old abrasion and reddish brown colour appearance of wound scab is 37.5.

Table 5: Percentage agreement with existing literature between 2-3 days old abrasion and reddish brown colour appearance of wound scab

	Reddish-brown colouration (Observed in literature)	Frequency n = 24	Percentage
Abrasion 2-3 days old	Correlating	09	37.5
	Not Correlating	15	62.5

On a total of 15 abrasions observed between 4 to 7 days, 7 abrasions were covered with brown colour scab, which amounts to 46.7 percent. Hence the percentage agreement between 4-7 days old abrasion and brown colour appearance of wound scab is 46.7.

Table 6: Percentage agreement with existing literature between 4-7 days old abrasion and brown colour appearance of wound scab

	Brown (Observed in literature)	Frequency n = 15	Percentage
Abrasion 4-7 days old	Correlating	07	46.7
	Not Correlating	08	53.3

All the abrasions observed after 7 days appeared to have a black scab which was fallen off at place, exposing healed hypo pigmented areas of skin. Hence the percentage agreement between a more than 7 days old abrasion and black colour appearance of wound scab is 100.

Table 7: Percentage agreement with existing literature between more than 7 days old abrasion and black colour appearance of wound scab and shedding of wound Scab

	Black colouration and Scab schredding (Observed in literature)	Frequency n = 14	Percentage
Abrasion beyond 7 days	Correlating	14	100
	Not Correlating	00	00

The 20 patients observed with head injury, fifty percent of the patient had healing pattern as described in the standard literature.

Table 8: Percentage agreement with existing literature between healing patterns of wounds with respect to time among patients with Head injury

	colour change pattern (Observed in literature)	Frequency n = 20	Percentage
Abrasion among head injury patients	Correlating	10	50
	Not Correlating	10	50

Among the 11diabetic patients observed 9 patients showed healing patterns as described in the standard literature, which amounts to 81.82 percent.

Table 9: Percentage agreement with existing literature between healing patterns of wounds with respect to time among patients with Diabetes

	Colour change pattern (Observed in literature)	Frequency n = 11	Percentage
Abrasion among Diabetic patients	Correlating	09	81.82
	Not Correlating	02	18.18

Study looks at the pattern of colour change in abrasion over a specific time line. The naked eye appearance of abrasions was matched with a standard colour chart for colour changes over a period of time and the observations obtained were compared with the standard literature, the percentage agreement of abrasion colour changes observed were then compared to similar studies by Lavlesh Kumar et al and Sandhu S. S et al.[1,9]

It was noted in our study that 16 abrasions in a total of 18 fresh abrasions were observed to be bright red in colour, which amounts to 88.9 percent. The percentage agreement between fresh abrasion and bright red colour appearance of abrasion is 88.9. Twenty nine abrasions observed between 12 to 24 hours after injury showed 16 abrasions to be red in colour, which amounted to 55.2 percent. Hence the percentage agreement between 12-24 hours old abrasion and red colour appearance of wound scab is 55.2.

Lavlesh Kumar et al[1] noted that on the first day, in their study, out of 45 cases 32 cases appeared dark red instead of bright red and Sandhu S. S et al[9] noted among the injuries between 7-12 hours 22 had bleeding, 34 depicted red colour scab, and among the 13-18 hours group 85 patients out of 89 depicted red colour scab, by 24 hours all abrasions were covered with a red coloured scab. In conclusion all three studies point red colour appearance of wound at 24 hours after injury. The current study emphasises on the bright red appearance of wound upto 12 hours, distinct from red coloured appearance, which was not commented in the aforementioned studies.

In the 24 abrasions, aged between 2 to 3 days, observed in the study, 9 of them appeared Reddish brown in colour, which amounted to 37.5 percent. The percentage agreement between 2-3 days old abrasion and reddish brown colour appearance of wound scab is lesser than the observed standard progression of wound maturation.

Lavlesh kumar et al[1] reported that on the 2nd day out of 6 cases 3(50%) cases appeared reddish black. On the 3rd day out of 6 cases 4(66%) cases appeared dark red. Sandhu S. S et al[9] reported that between 25-36 hours 11 injuries depicted red brown scab among the 89 observed. 74 abrasions were covered with a red scab and 49 covered by red brown scab among the 123 abrasions observed between 37-48 hours. Shedding of scab started on day three, among those between days 3 to 5 out of 138 cases 21 cases still had reddish brown scab whereas 70 cases depicted partial shedding of scab and there was complete shedding of scab in 47 cases.

Our study has findings similar to the findings of Sandhu S. S et al[9] stating the low percentage agreement of reddish brown appearance of abrasion 2 to 3 days after the injury.

Among the 15 abrasions observed in our study which were between 4 - 7 days, 7 appeared brown in colour, which amounts to 46.7 percent. The percentage agreement between 4-7 days old abrasion and reddish brown colour appearance of wound scab is more than the abrasions of 2-3 days old compared to standard literature.

All the abrasions observed in our study, after 7 days appeared to have a black scab which was fallen off at place, exposing hypopigmented healed areas of skin. The agreement between a more than 7 days old abrasion and black colour scab is high.

Lavlesh Kumar et al[1] reports that on the 5th day out of 6 cases, 84% cases appeared dark red. On the 9th day all are dark brown in colour during the first three days, the colour appeared bright to dark red, by 9th day the colour changed to dark brown and complete healing was seen by 20th day in 8.6% of cases.

Sandhu S. S et al[9] reports that average duration of formation of reddish brown scab is from 36 hrs to 10th day. Partial shedding of scab is seen from 3 days to 10 days. Complete shedding of scab is seen between 5-10 days. Discoloured skin is seen between 7-10 days. Regeneration and appearance back to normal skin is observed 10 days onwards.

Thus all the studies point towards a low agreement on colour change as a method to ageing injuries between 3 to 7 days. Findings are reinforced by the fact that on statistical analysis Spearman's rho showed very strong positive correlation between time since injury and colour of abrasion to be 0.902 (p value<0.001).

It is also observed that the percentage agreement between the healing patterns of abrasions with the standard literature was higher among fresh abrasions and in abrasions aged more than seven days. The correlation seems above par in comparison to the day-to-day clinical assessment and observation. Hence, the data was reassessed after excluding the two groups with high percentage agreement i.e., less than 12 hours and more than 7 days for correlation by Spearman's test. Then it was observed that there was a significant fall in the correlation coefficient to 0.749 (p value <0.001) which was still significant.

Among the patients with head injury the percentage agreement falls to 50 percent and among diabetes it is 81.82 percent, much higher as compared to head injury patients inferring that head injury has a greater impact on healing of abrasions as compared to diabetes, also a small sample size of diabetic patients does not provide the real picture as to the effect of diabetes on healing pattern of abrasions.

The Spearman's rho for patients with head injury showed Correlation Coefficient between time since injury and colour of Abrasion to be 0.553(p value 0.012), which shows that head injury has a significant impact on the healing of abrasions.

The Spearman's rho for patients with diabetes showed Correlation Coefficient between time since injury and colour of Abrasion to be 0.902(p value <0.001). The value does not show a significant change in the healing pattern of abrasions among diabetic patients. This could be due to the small sample size of diabetic patients in the study, hence it could be stated that a bigger sample size would be required to study the effect of diabetes on healing pattern of abrasions.

It is evident from the studies that the colour change in abrasion with lapse of time varies from person to person and also among different geographic areas. The current literature can be used for ageing abrasions but can often be misleading. The deviations observed in individuals could be linked to the individual himself or to various external factors.

CONCLUSION

- Ageing of injures as per the standard literature is not a fool proof method in crime investigation.
- Abrasions within 24 hours and beyond 7 days have a higher accuracy in ageing based on naked eye examination.
- Ageing of abrasions between 12 hours to 7 days have a very high chance of inappropriate judgment of the time lapsed.
- It is noted that head injury prolongs healing in this study and hence needs further inquiry to analyze its affect on healing of abrasion and possibly its correlations with severity of head injury.
- The effect of diabetes is well known and its effect was not evident due to small sub-sample size.

Conflict of Interest: Declared none

Source of Funding: Self

Ethical Clearance: All Ethical parameters were taken care of in the study

REFERENCES

1. Lavlesh Kumar, Chaitanya BV, Swapnil S Agarwal, Binaya Kumar Bastia. Age Related Changes in Mechanical and Thermal Injuries-A Post Mortem Study. J Indian Acad Forensic Med 2011April-June; 30(2): 149-151.
2. Tedeschi C.G., Eckert GW. & Tedeschi LG. Forensic Medicine- A study in trauma and environmental hazards .1st ed. W B Saunders Company. Philadelphia, London, Toronto; 1977:3, 5, 22
3. Narayan Reddy K.S. Mechanical Injuries. In: The Essentials of Forensic Medicine and Toxicology. 29th ed. Hyderabad: Medical Book Company; 2010:162-165.
4. Mukherjee JB.Forensic medicine and toxicology .2nd ed. Arrnold Associates, New Delhi; 1994: 29, 224, 244-8.
5. Knight B and Saukko P.Knight's Forensic Pathology. 2nd ed. Arnold, a member of the Hodder Headline Group, London NW 13B H; 1996,135
6. Langlois NE, Gresham GA. The ageing of bruises: A review and study of the colour changes with time. Forensic Sci Int. 1991; 50: 227-38.
7. Modi JP.Modi's Medical Jurisprudence and Toxicology.23rd ed. Buttertworths-Wadhva Nagpur; 2010:694
8. Hex Color Codes.Visi bone .com. Cited on july 22,2013, from Visibone.com,Bob Stein. VisiBone: 2013.website: http://html-colorcodes.com/
9. Sandhu S. S, Gorea RK, Gargi j, Garg Anil. Age estimation of injury from abrasion- A Clinical Study from north India. J Punjab Acad Forensic Med Toxicol 2009;9(2)