

# Study of Spectrum of Various Pressure Abrasions Caused by Ligature Material in Violent Asphyxial Deaths

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## Abstract

From since a long time, in day to day work deaths due to pressure around the neck have been found to be a common cause of death during post mortem examination. Hanging and ligature strangulation are the two forms of violent mechanical asphyxia in which ligature mark is found. The study was conducted in department of forensic medicine and toxicology at J.L.N. Medical College, Ajmer for a period of one year i.e. from June 2019 to June 2020. During this period a total number of 104 cases of violent asphyxia death caused by pressure abrasion due to ligature were observed. In the present study types of ligature material used and pressure abrasion produced by them in different situation and their manner of infliction is discussed. In this study chunni (soft material) was the most common ligature material used i.e. in 32.6% cases. Fixed knot pattern was the most common (94 %of total cases). Most of the cases were occurred in closed space (room)

**Keywords:** pressure abrasions, hanging, ligature strangulation, Ligature materials

## Introduction

Pressure abrasion due to compression around neck by a ligature is a far old practice to commit suicide or homicide in mankind. It is a painless (or minimal pain inflicted) and sudden procedure. Ligature mark is found in two types of neck compression (1) hanging (2) ligature strangulation. Hanging is a form of death produced by suspension of the body by a ligature round the neck, constricting force being the weight of the body (or a part of the body weight) <sup>1</sup>. A good number of people die each year by suicide adopting various methods in the world according to WHO (world health organization) and research reports<sup>2,3</sup>. In India hanging is among the top 5 methods of choice for committing suicide <sup>4</sup>. The type and position of knot play an important role in the causation of death in hanging <sup>11</sup>. It is represented by an inverted “v” shaped mark <sup>9</sup>.

In strangulation cases ligature material applied around the neck or less, as homicide have been perpetrated by assaulter pulling (U shaped) ligature against the front <sup>14</sup> and side of neck or (turn around the neck) O shaped encircling the neck, while standing at the back. It is also well known fact that discontinuity along the course of the ligature mark is another important criterion while describing ligature mark of hanging or strangulation.

Authors have mentioned that hanging mark almost never completely encircles the neck <sup>5-6</sup>. In strangulation, unless the killer is pulling upwards, there will be no gap in the mark. However, there can be discontinuity along the course of ligature mark due to interposing clothing, scalp or beard hairs or fingers of victim in both hanging and strangulation <sup>6</sup>.

In hanging cases obliquity along the course of ligature mark over the neck is common and conclusive finding. Authors have reported that hanging mark is situated obliquely across the circumference of neck <sup>6-9</sup>. The mark of hanging usually rises to a ‘peak’ pointing the junction of the noose and vertical part of the ligature, this being a distinguishing feature from ligature strangulation <sup>5</sup>. Thick and long beard or clothes on neck may lead to

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formation of dull and ill formed ligature mark; thus, the ligature mark becomes a crucial aid in diagnosis and evaluation of dead body. It becomes dry, hard and parchmented, after couple of hour after death, if the skin has been excoriated. The pattern of ligature may also be seen. Hence, examination of ligature material and mark becomes an indispensable part of autopsy. It is a known fact that it is difficult to differentiate the ligature marks of hanging and strangulation, in this study an attempt will be made to establish different characteristics findings of patterns of ligature marks in hanging and strangulation cases.

### Material and Method

The study was conducted in department of forensic medicine and toxicology at J.L.N. Medical College, Ajmer for period of one year i.e. from 6th June 2019 to 23 June 2020. During this period a total number of 104 cases of violent asphyxial death caused by pressure abrasion due to ligature around the neck that

were received at mortuary were observed. Thorough external examination was done and approximate age, sex, position of body, stains (blood, saliva, semen) were determined. Much more emphasis was made over ligature material, appearance of ligature mark. A meticulous local external examination of neck was done with naked eye and hand lens to quantify and correlate ligature mark with its appearance in relation to material, impression, pattern, colour, course, type of knot, level of ligature, skin changes over the ligature mark etc. A standard autopsy technique was adopted.

### Observations and Result

During the study period total 927 bodies were brought to J.L.N. Medical College mortuary for post-mortem examination out of which 104(11.21%)cases were of hanging and strangulation. Out of these 104 cases 98 cases were of hanging and 6 cases were of strangulation. History about the incident was taken from the police & relatives.

**Table 1: shows age-wise distribution of cases**

No. of Cases M/F Age Group	Male	Female	Total no. in per age group	Total
<20	9(8.65%)	5(4.80%)	14(13.46%)	104(100%)
20- 29	23(22.11%)	15(14.42%)	38(36.53%)	
30-39	25(24.03)	7(6.73%)	32(30.76%)	
40-49	8(7.69%)	2(1.92%)	10(9.61%)	
50- 59	6(5.76%)	1(0.96%)	7(9.61%)	
≥60	3(2.88%)	0(0%)	3(2.88%)	

As shown in **Table no. 1** maximum number of cases were In the age group of 20-29 yrs i.e 38 cases (36.53%) followed by age group 30-39 yrs number of cases were 32 (30.76%). Minimum age recorded was 14 yrs and maximum was 100 yrs.

**Table 2: Shows distribution of ligature material**

S. No.	Ligature material	No. of Cases	104(100%)
1.	Chunni	36(34.61%)	
2.	Stole	21(20.19%)	
3.	Cotton Rope	17(16.34%)	
4.	Sari	10(9.61%)	
5.	Nylon Rope	9(8.65%)	
6.	Bed Sheet	5(4.80%)	
7.	Niwar	2(1.92%)	
8.	wire	2(1.92%)	
9.	Belt	1(0.96%)	
10.	Turban	1(0.96%)	

As shown in **table no. 2** the most commonly used ligature material was chunni 36(34.61%) followed by Stole 21(20.19%) and Cotton Rope 17(16.34%) Least used material was belt and Turban 1(0.96%).

**Table 3: Distribution of hanging and strangulation cases on the basis of encirclement of ligature mark**

Encirclement		Hanging	strangulation	Total
Continuous	Transverse O shaped	0	4	10(9.61%)
	Oblique O shaped	6	0	
Discontinuous	Transverse U shaped	0	1	94(90.38%)
	Transverse Interrupted	0	1	
	Oblique	79	0	
	oblique V shaped	13	0	
Total		98	6	104 (100%)

Among 6 cases of strangulation, 4 cases were homicide in nature and 2 were accidental type. Horizontal U shaped ligature mark was seen over the neck in 1(0.96%) case and in 3 cases (2.88%) ligature was encircled the neck completely in O shaped manner.

In accidental strangulation, ligature mark in one case was horizontal interrupted and for another case it was horizontal O shaped. In all 6 cases of ligature strangulation hematoma was found in the neck muscles and other structure. In 4(66.6%) out of 6 strangulation cases the

ligature mark was complete. Among 98(94.23%) cases of hanging oblique V shaped ligature mark was present in 13(12.5%) cases. Oblique O shaped ligature mark seen in 6(5.76%) cases, mostly seen in tight loop noose. Internal finding of neck in all cases of hanging was pale, white, glistening underlying soft tissue. In this study I

noticed that ligature mark can seen over neck in different ways like O shaped, Ushaped, V shaped as per ligature material run over neck. 10(9.6%) cases out of 104 cases had complete encircling of ligature mark around neck, rest of 94(90.3%) cases had interruption in continuity of ligature mark.

**Table 4: pattern of ligature mark**

Level			Length of ligature			Direction		Total Cases
ATC	OTC	BTC	≤NC	≈NC	≥NC	Oblique	Transverse	
94(90.3%)	7(6.73%)	3(2.88%)	93(89.42%)	7(6.73%)	4(3.84%)	98(94.23%)	6(5.76%)	104

In 94(90.3%) cases out of 104 ligature mark was found above the thyroid cartilage, in 7 cases (6.73%) ligature mark was present over the thyroid cartilage and in remaining 3 (2.88%) cases it was below the thyroid cartilage . In these reported cases there were 93(89.42%) cases in which length of ligature mark was less than neck circumference in 7(6.73%) cases length of ligature mark was equals to neck circumference and 4(3.84%) cases it was more than that. ligature mark was placed obliquely in 100(96.1%) cases out of 104 and in 4(3.84%) it was transverse. Knot impression was present on either side of neck in inverted “v” shape in 30 cases out of 104.

**Table 5: colour and appearance of ligature mark**

Total Cases	Not visible	Soft faint non parchmented	Parchmented reddish brown	Parchmented Leathery dark brown
104	7(6.73%)	8(7.65%)	36(34.61%)	53(50.96%)

Ligature mark was parchmented reddish brown in 36 (34.61%) cases out of 104 cases, in 53(50.96%) it was with parchmented leathery dark brown changes of skin, skin of ligature mark in 8 (7.65%) cases were soft non parchmented and in rest of 7(6.73%) cases skin changes not visible. As per history given by relatives there were 25 (24.03%) cases, in which suspension time was more than 6 hrs which was evident by position livor mortis, there were 68 cases (65.38%) in which suspension time was from few minutes to 6 hr, 11 (10.57%)cases were reported within few minutes of suspension. The pressure abrasion of ligature mark is found well grooved in 19 cases where in suspension period is more than 6

hrs. The longer the body is suspended the deeper and prominent will be the ligature groove<sup>22</sup>.

The pressure abrasion was not visible in 15(14.42%) cases where in suspension time was within few minutes as well as the time elapsed after death was within 6 hrs. The time since death gradually increases, by then the consistency of pressure abrasion also increases more towards parchmentation. In 36(34.61%) cases pressure abrasion was found fairly parchmented and reddish brown up to the depth of epidermis in which time elapsed after death was nearly 12 hrs. in 53(50.69%) cases pressure abrasion parchmented and leathery, in

most of cases dark brown up to the depth of dermis in which time elapsed after death was nearly 24 hrs.

## Discussions & Conclusion

In our study 38 cases were observed in age group 20-29 years then 32 cases were observed in age group 30-39 years. These findings were similar to the findings of studies previously done by Kumar et al<sup>17</sup> 21 to 30 years of age, other previous studies by Yadav et al<sup>18</sup>, Meera and Singh<sup>19</sup>, also reported the largest age group to be affected as 21 to 30 years.

In present study, chunni was the most common used ligature material (32.6%) which is very common cloth in wardrobe. Studies by Naik S K et al<sup>12</sup>, Sharma B R<sup>13</sup>, have shown variation with this but both concluded on that soft material being more commonly used than the hard one. Meera and Singh<sup>19</sup> in Manipur, Who were also reported that the most common ligature material to be used was sari or dupatta, followed by wire/rope. However, study done in Ranchi by Kumar et al<sup>17</sup> concluded that hard ligature material such as rope was most common.

In present study maximum no. of cases (90.3%) showed ligature mark above the thyroid cartilage, 7 (6.73%) had mark over thyroid cartilage level and 3(2.88%) had marks below thyroid cartilage level. This was comparable with the findings of the study done by ballur<sup>20</sup>, who observed that in 83% of cases. Another study did by Sudheer and Nagaraja<sup>21</sup>, who reported 88% cases, have ligature marks above the thyroid cartilage. This coincides with a study done by Reddy KSN, which showed that in 80% cases ligature marks situated above thyroid cartilage level between chin and larynx, in 15 % cases at the level of thyroid cartilage and in 5% cases below the cartilage<sup>9</sup>.

Among 6 cases of strangulation, in 3 cases (50%) ligature mark was situated below the thyroid cartilage, in rest 3 cases (50%) in situated over the thyroid cartilage level. Among 104 cases 98 cases(94.23%) cases were hanging, in which direction of ligature mark was oblique which was consistent with observation by Naik S K<sup>12</sup>, in all 6 cases of ligature strangulation, the direction of the ligature mark was Transverse which was consistent with observations of Naik S K<sup>12</sup>. In this study the ligature mark was continuous in 10(9.61%) and non continuous

94(90.38%) study cases

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**Conflict of Interest:** The recent episode of suicidal demise of sh. Shushant Singh Rajpoot, A celebrity prompts and inspires me to publish paper on pressure abrasions over neck in violent asphyxia deaths.

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## References

1. Mathiharan K, Patnaik AK. Modi's Medical Jurisprudence and Toxicology. Lexis Nexis Butterworth, India, New Delhi. 2005; 23<sup>rd</sup> edition: 1000, 565
2. Varnik A, Kolves K, Van Der Feltz-Cornelis CM, Marusic A, Oskarsson H, et al. Suicide methods in Europe: a gender –specific analysis of countries participating in the “European alliance against Depression”. J Epidemiol Community Health. 2008; 62: 545-51.
3. Ajdacic- Gross V, Weiss MG, Ring M, Hepp U, Bopp M, et al. Methods of suicide international suicide patterns derived from the WHO mortality database. Bulletin of the World Health Organization. 2008; 86: 726-32.
4. Bhatia M S, Agarwal N K, Millo T, Murthy O P. Suicide note, and psychological autopsy, International Journal of Medical Toxicology and Legal Medicine 1999; 16: 38-39.
5. Simpson K. Simpson's Forensic Medicine, By knight B. 1997; 11<sup>th</sup> edition: 92-94
6. Knight B. Forensic Pathology, Arnold Publication. 1996; 2<sup>nd</sup> edition: 361-389
7. Modi JP. Modi's Medical Jurisprudence & Toxicology, Butterworth's. India, New Delhi, 1988; 22<sup>nd</sup> ed. By Subramanian BV: 251-272
8. Nandy A. Principle of Forensic Medicine, New Central book Agency Pvt. Ltd, Calcutta. 2000; 2<sup>nd</sup> ed: 315-323
9. Reddy KSN. The Essential of Forensic Medicine & Toxicology, Published by K. Suguna Devi, Hyderabad. 2000; 19<sup>th</sup> edition: 283-295

10. Jason PJ, Anthony B, William S. Forensic Medicine- clinical and pathological aspects. Greenwich Medical Media Ltd, London. 2000; 1<sup>st</sup> edition: 266-269
11. D S Badkur, J Yadav, A Arora, R Bajpayee, BP Dubey. Nomenclature for knot position in hanging- a study of 200 cases. *J Indian Acad Forensic Med.* 2012 Jan- March; 34(1): 34-36
12. Naik S K, Patil D Y. Fracture of hyoid in cases of asphyxia deaths resulting from constricting force round neck. *Journal of Indian academy of forensic medicine (JIAFM).* 2005 October – December; 27(3): 149-153
13. Sharma B R. A study of ligature mark on neck: how informative?. *Journal of Indian academy of forensic medicine (JIAFM).* 2005 January- March; 27(1): 10-15.
14. Nawal k S, Kumar S, Tulsi M, Ajit K C, Shakti G. A Comparative study of ligature marks in case of hanging and strangulation autopsied at RIMS, Ranchi. *IOSR Journal of Dental and Medical Sciences (IOSR\_JDMS).* 2018 August; 17(8)(12): 01-05
15. Ajitesh Pal and H K Pratihari. Unusual Hanging- A Case Report. *J Forensic cri. Studies.* 2017;1:101
16. Singh Amandeep. A Study of demographic variables of violent asphyxial death. *Journal of Punjab academy of forensic medicine & toxicology.* 2003; 3: 32-34
17. Kumar N, Sahoo N, Panda B B, Hansda M K. Fracture of Hyoid bone and thyroid cartilage: an autopsy study. *J Indian Acad Forensic medicine.* 2016; 38: 393-6
18. Yadav A, Kumar M, Tellewars, Lolit Kumar R. Study of fracture hyoid bone in hanging cases. *J Indian Acad forensic med.* 2013;35:239-41
19. Meera T, Singh MBK. Pattern of neck findings in suicidal hanging : A Study in Manipur. *J Indian Acad forensic medicine.* 2011;33:352-4
20. Ballur MS. Analytical study of deaths due to hanging cases reported at Dr. B.R. Ambedkar medical college mortuary during 2010-2012 [Masters Thesis]. Bangalore: Rajiv Gandhi University of Health Sciences, Karnataka. 2013.
21. Sudheer TS, Nagaraja TV. A study of ligature mark in cases of hanging deaths. *Int J Pharm Biomed Sci.* 2012; 3:80-4.
22. Tanuj k, Alok A, Babu Y P R, Shankar M B. Putrefaction, Hanging and Ligature mark. *International Journal of A J Institute of Institute of Medical Sciences 2.* 2014; 112-118.