

# An Autopsy Study of Examination of Neck Injuries & Face, in deaths due to Suicidal Hanging

Dinesh Rao<sup>1</sup>

<sup>1</sup> Professor & HOD, Department of Forensic Medicine. TOMCH. Bangalore 562107, India

\*Corresponding Author: Dr. Dinesh Rao. MBBS, DFM., MD., DNB., LLB., FFLM [UK]. Professor & HOD, Department of Forensic Medicine. TOMCH. Bangalore 562107, India. E-mail: [dr-rao-forensic@yahoo.com](mailto:dr-rao-forensic@yahoo.com)

Received: December 03, 2021; Accepted: December 23, 2021

## Abstract

This Study on Injuries to the Neck Structures was conducted on over 634 cases of Suicidal Hanging during the Period 2009 to 2020. The Aim of the Study is to Understand the Damage to the Neck structures Externally and Internally, with Particular Reference to Sternocleidomastoid Muscle, Internal Carotid Artery, Thyroid, Cricoid, Laryngeal Cartilage and Hyoid Bone. The Cervical Spine was also Examined for Fractures. The Thyroid Gland and Parotid Gland Were Studied Microscopically. The Ligature Mark changes and the Conjunctiva were Examined. The Changes in complete and Partial Suspension was Examined and Compared. The Neck dissection technique, as advocated by Prinsloo and Gordon was undertaken to study the injuries to the thyro-hyoid complex, strap muscles, carotid vessels, etc. Females Formed the Major Number 62% of cases. In Complete Hanging Injury and Hemorrhages of the Sternocleidomastoid muscles at sterna end was noted in 86% of cases whereas it was recorded in only 8% of cases in Partial Hanging. The protrusion of Tongue and Dribbling of Saliva was well appreciated in 98% and 92% of cases respectively in Complete Hanging, whereas it was appreciated in 38% and 46% respectively, in Partial Hanging cases. The Obliquity of Ligature Mark was well appreciated in All the cases of Complete Hanging whereas it was reported in only 72% cases of Partial Hanging. Capsular & Parenchymal Hemorrhages of the Thyroid and Parotid Gland was reported in 68% cases of Complete Hanging, but only 8% of Partial Hanging reported the Histological Changes. The epithelial structures over the Ligature Mark along its Margins were displaced upwards and downwards in 91% of Complete Hanging whereas it was reported in 29% of Partial Hanging. Hence Understanding the Structural Damage to the Neck is always important to understand the Suicidal Hanging.

**Keywords:** Face & Neck injuries, Suicidal Hanging, Neck Structures, Dribbling of Saliva, Ligature Mark, Typical Hanging.

## INTRODUCTION

Hanging is a common method of suicide in which a person applies a ligature to the neck and brings about unconsciousness and then death by suspension or partial suspension. Hanging is a Form of Mechanical Asphyxia, wherein the Constriction of the Neck is from a Ligature Encircling the Neck, the Constricting Force being the Weight of the Body <sup>[1]</sup>. In the U.S., hanging is the second most common method, after self-inflicted gunshot wounds <sup>[2]</sup>.

Hence, Death due to hanging is not unusual across the world, this makes the majority of Asphyxia deaths. Majority of Hanging cases are considered as suicidal until the contrary is proved. Many a times the suspicion about hanging is Postmortem Suspension of the body to conceal Crime, is always raised especially in death of a Newly Wedded Women or Death involving Young Adult individual. Hence Careful forensic examination is of necessary to end the speculation and ascertaining the Antemortem Nature <sup>[3, 4]</sup> of Suspension so as to

exclude the allegations of Concealment of Crime. External Examination Changes seen on the Neck and Face, changes on the Skin due to Ligature Mark, Face and Conjunctiva differs from Complete and Partial Hanging and Also Variations reported from Different Authors in the Pathophysiological Process of Hanging. Some of the External features In Hanging helps us to Differentiate Ante mortem and postmortem Hanging like Epithelial Heaping of the Ligature Mark with Petechial hemorrhages, La Fascia Sympathetique, Petechial Hemorrhages in the conjunctive, Swelling of Face and Congestion & Dribbling of Saliva along the angle of the mouth. It should also be noted that all the signs described may be absent in cases of Sudden death due to Vagal Inhibition in hanging. So, petechial hemorrhages cannot be taken as a specific feature of ante mortem hanging. Furthermore, the Ligature Mark that is the Principle indicator of Hanging can artificially be produced by suspension during death or immediately after Death, however the Internal Damage to the structures cannot be produced by this Artificial Mean. Hence the study of Internal Damage to the Neck Structures is very essential to understand the Ante mortem Nature of Hanging and at the same time understand Suicidal

hanging.

## MATERIALS & METHODS

The Autopsy was carried out Exploring all the body Cavities and Neck was the Last Region to be Dissected, thereby facilitating a blood less field on the Neck Region. A total of 634 cases of Suicidal Hanging reported out of 9684 cases of Autopsies Conducted during the Period 2009-2020, at Kingston and Bangalore. The Neck Structures were Examined Externally and Internally, Layer by Layer Dissection was conducted. The External Examination was Limited to Skin over the Ligature Mark and its surroundings, Protrusion of Tongue and Dribbling of Saliva and Changes in the Conjunctiva Changes. The Internal Changes were Carried out in particular reference to Sternocleidomastoid Muscle, Internal Carotid Artery, Thyroid, Cricoid, and Trachea, Hyoid Bone, Cervical Vertebra. Microscopical Examination of Thyroid and Parotid Gland was done in all the cases. The Damage to Internal Carotid Artery was studied under Toluidine Dye Examination. The Examination findings were documented separately, Compared and Analyzed for Complete and Partial Hanging.

## RESULTS

A Total of 634 cases of Suicidal Hanging were reported out of 9684 Autopsied conducted during the Period 2009-2020. Complete Hanging Contributed to 72% [n-] of cases [Figure no 01] and Partial Hanging comprised 28% of the Cases. Females outnumbered and contributed to 62% of cases [Figure no 2]. Slip knot was used in 89% of cases [Figure no 03]. The Position of the Knot over the Nape of the Neck was Found in 77% of cases [Figure no 04] and only in 5% of cases the knot was found in the front of the Neck, others were found over the sides of the Neck.

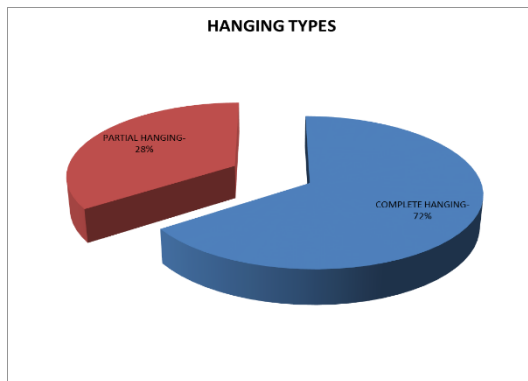


Figure 1: Hanging Types.

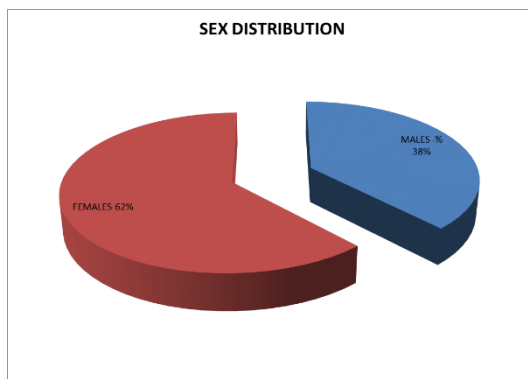


Figure 2: Sex Distribution of Suicidal Hanging.

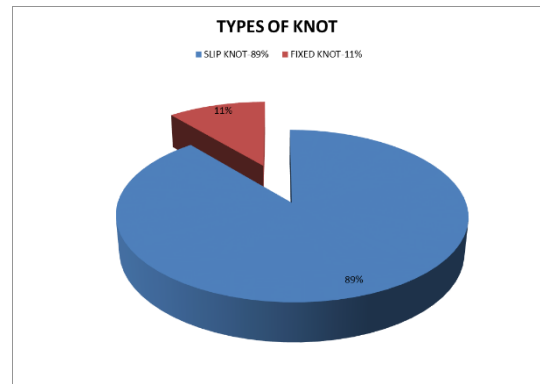


Figure 3: Different Types of Knot.

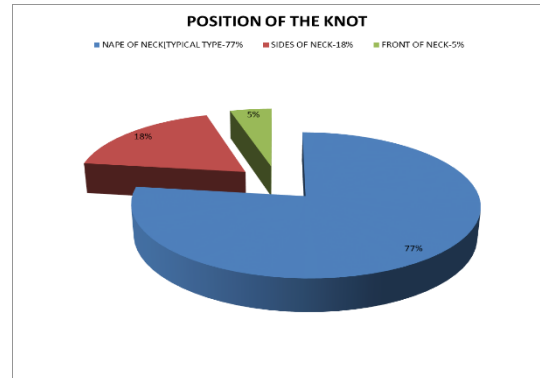


Figure 4: Different Positions of The Knot.

Table no 01-Describes the External Examination, Face & Neck Findings in Suicidal Hanging.

Table 1: Describes the External findings-Face & Neck, in Suicidal Hanging.

S No	External Findings	Complete Hanging n-456	Partial Hanging n-178
01	Tongue Protrusion	98%[n-447]	38%[n-68]
02	Petechial Haemorrhages in conjunctiva	01%[n-5]	49%[n-87]
03	Dribbling of Saliva	92%[n-420]	46%[n-82]
04	Haemorrhage around the Ligature Mark	01%[n-5]	28%[n-50]
05	Epithelial Tissue over Ligature Mark Displaced at Margins and Blackened.	91%[n-415]	29%[n-52]
06	Oblique Shape Ligature Mark	100%[n-456]	72%[n-128]
07	Horizontal Shape Ligature Mark	00	28%[n-50]
08	Congested Eyes	01%[n-5]	36%[n-64]
09	Face Swelling and Congestion	00[n-387]	36%[n-64]
10	Bleeding through Nose	00[n-387]	08%[n-14]
11	Self-Inflicted Nail Marks on Neck & Face	03%[n-15]	00[n-387]
12	La Fascia Sympathetique	19%[n-87]	06%[n-11]

In Majority [98%] of Complete Hanging the Tip of Tongue was protruded out of Mouth but the same was seen in only 38% of Partial Hanging. The Oblique Shape of Ligature Mark was seen in almost all cases of complete hanging, whereas it was reported in only 72% of Partial Hanging Cases. The Epithelial Tissue over the Ligature Mark of 91% of Complete Hanging showed Displacement Upwards or Downwards along its Margins but the same was observed in only 29% of the Partial Hanging. Dribbling

of Saliva along the angle of Mouth was present in only 92% of Complete Hanging and 46% of Partial Hanging. Facial Congestion, Bleeding through the Nose and Hemorrhages around the Ligature Marks is almost Unseen in Complete Hanging, whereas it is seen in 36%, 36% & 28% of cases Respectively in Partial Hanging Cases. An Unusual Signs of Self Inflicted Nail Marks over the Neck and Face present in 3% of Partial Hanging. The La Fascia Sympathetique, Opening of the Eyelid was present on one side in 19% of the Cases in Complete Hanging, whereas only in 6% of Cases in Partial Hanging it was reported.

Table no 02-Describes the Internal Examination, Neck Structure injuries Findings in Suicidal Hanging. The commonest and the most frequent Muscle Damaged in 86% cases of Complete Hanging was Sternocleidomastoid Muscle, at the Sternal End, whereas it was noted in only 08% of Partial Hanging. A Transverse Tear in of internal Carotid Artery was reported in 67.27% of Cases of Complete Hanging, but the same changes were observed in only 3.6% of cases of Partial Hanging. Capsular and Parenchymal Hemorrhages were noted in Thyroid Gland and Parotid Gland in 68% & 38% of Complete Hanging Respectively whereas it was only seen in 08% & 02% of Partial Hanging. The Thyroid Cartilage, Cricoid Cartilage, Cervical Vertebra and Hyoid Bone showed No Damage in partial Hanging. In cases of Complete Hanging the Thyroid Cartilage, Cricoid Cartilage, Hyoid Bone & Cervical Vertebra were found to be damaged in only 06%, 01%, 05% & 04% respectively, whereas there were no damage reported to Trachea.

**Table 2:** Describes the Internal Injury to Neck Structures in Suicidal Hanging.

SI no	Internal Findings	Complete Hanging n-456[72%]	Partial Hanging n-178[28%]
01	Sterno Cleidomastoid Muscle- Haemorrhages at the Sternal End	86%[n-392]	08%[n-14]
02	Cervical Vertebra	04%[n-18]	00
03	Thyroid Cartilage Damage	06%[n-27]	00
04	Hyoid Bone Fracture	05%[n-23]	00
05	Capsular & Parenchymal Haemorrhages in Thyroid Gland	68%[n-310]	08%[n-14]
06	Capsular Haemorrhages in Parotid Gland	38%[n-173]	02%[n-4]
07	Transverse Tear in the Internal Carotid Artery	67.27%[n-307]	3.6%[n-6]
08	Trachea	00%	02%
09	Cricoid	01%	00%

## DISCUSSION

In the Present Study a Total of 634 cases of Suicidal Hanging were Autopsied of the Total 9684 cases of Autopsy conducted during the period 2009 to 2020. Suicidal Hanging formed only 6.5% of Autopsies. Similar studies conducted by Hassan *et al.* [5] in a two year period in Kuwait reported a total of 118 cases. In another study conducted by Kumar and Verma [6] in Lucknow (India) a total of 4405 cases were autopsied in a five year period of which only 10% of cases were due to hanging. Dean *et al.* [7] had studied on 229 cases. Hence regional socioeconomic and Cultural factors play an important role in Suicidal Hanging.

In the Present Study Females were the Major Victims contributing to 62% of Victims [Chart no 01] and The Males Contributed to only 38% of Cases of Self Suspension, This

observations were close to those of Rehman md *et al.* [8], who in his study reported 55% Females and 45% Males Victims, but the number of Cases studied in his Five year study were 312 Victims. The observations made by Kurtulus *et al.* [9], Jayaprakash and Sreekumar [10], Suminska-Ziermann [11] and Al Madni *et al.* [12] are more deviating as they found that the Males were more affected than females in the ratio 3:1. This wider variation in the sex group is possibly due to the cultural, religious, economic and lifestyle factors driving the individual to Suicidal Hanging. In the Present study the Hanging Types, Complete and Partial were Examined [Chart no 02], Compared and Analysed separately, this makes the Study more Unique and Different from other studied carried out else where, at the same time it also helps us to understand better Suicidal Hanging. In the Present Study 72% of the Hangings were Complete [Chart no 02] whereas 28% of Hanging were Partial in Nature these results are close to the observations made by Sharma *et al.* [13] and Saisudheer and Nagaraja [14], in their study, 68% and 64% of the cases respectively were due to Complete Hanging, however these observations are contrary to those made by Dean *et al.* [7] and Pradhan *et al.* [15]. They observed that 83.4% [n-229] and 47.37% of their cases were due to Partial Hanging, all these observations highlight the regional influence, lifestyle and to a certain extent the type of residence. The Present Study Slip knot [Chart no 03] contributed to 89% and 77% of cases the Position of the knot [Chart no 04] was in the nape of the Neck. All this are important factor that determine the Shape of Ligature Mark and the Completeness of the Ligature Mark.

The Ligature Mark in Complete hanging were always Oblique [100%] whereas the Obliquity of Marks was reported in only 72% of cases of Partial Hanging. The Horizontal Nature of Ligature Mark was reported in 28% of Partial Hanging but the same was never seen in Complete hanging. Hence the Presence of Horizontal Ligature Mark and Absence of Oblique Ligature Mark should always look under suspicion. This results are deviating from those observation made by Jayaprakash and Sreekumar [10], however the Horizontal ligature mark was noted in Partial Hanging. In the Present Study 89% of the Knots Used were Slip Knot Type only 11% were Fixed or Grannys Knots, whereas in 77% of the Hanging the Knot was present over the Nape of the Neck [Typical Hanging] and only in 5% cases the Knots was present over the front of the Neck. These results are close to those made by Sharma BR *et al.* [13], wherein he reported atypical Hanging in 88% of his Victims but disagreed with the results of Knot Type, wherein he had reported usage of Fixed knot in 71% of his Victims.

The Epithelial Tissue over the Ligature Mark of 91% of Complete Hanging showed Displacement Upwards or Downwards along its Margins but the same was observed in only 29% of the Partial Hanging. This feature also confirms the Antemortem Nature of Hanging because this process of Displacing of Epithelial Tissue is due to Extreme Hyperflexion [Decorticate] and Hyperextension [Decerebrate] of the Neck during the Process of Hanging and it is more Observed in Complete Hanging because of the Resistant Constricting Force due to Complete Weight of the Body. The blackening or darkening of the displaced skin is possibly due to the heat generated during the friction of ligature material against the skin surface. The author considers these observations as one of the factors in determining the ante mortem nature of hanging; these observations were not found in similar studies done elsewhere. Dribbling of Saliva along the angle of Mouth was present in only 92% of Complete Hanging and 46% of Partial Hanging, this is possible due to the possibility in case of Complete Suspension wherein the Neck is squeezed by the Constricting Force by the Weight of Body against the Gland and the Mandible in Complete Hanging, whereas the



severity of this process is compromised in Partial hanging due to reduced Constrictive Force. Facial Swelling Congestion, Bleeding through the Nose and Hemorrhages around the Ligature Marks is almost Unseen in Complete Hanging, whereas its seen in 36% & 28% of cases Respectively in Partial Hanging Cases. This is due to the possibility of Incomplete Compression of Neck in Partial Hanging thereby leading to continued Circulation in Vertebral Arteries leading to severe Congestion and the absence of this Signs in Complete hanging due to Complete Compression of Vessels leading to Cerebral Anemia. An Unusual Signs of Self-Inflicted Nail Marks over the Neck and Face present in 3% of Partial Hanging, this is possible due to the Involuntary act of the Victim during the Disorientation and Decorticate phases of Hanging, wherein involuntary or volitional attempts made to ward of the constricting Neck force. Another important Feature that confirms Antemortem Nature of Hanging is the presence of La Fascia Sympathetique, i.e., Dilatation of the eyelid on One side of the eye, wherein the Cervical Sympathetique Nerve is Stretched and Compressed as a result of Constricting Force of the Ligature on the neck due to weight of the body. In Partial Hanging the same was reported in 6% of cases possibly due to lesser Constricting Force and less pressure over the Cervical sympathetique nerve.

Table no 02-Describes the Internal Examination Findings in Suicidal Hanging. The commonest and the most frequent Muscle Damaged in 86% cases of Complete Hanging was Sternocleidomastoid Muscle, at the Sternal End, whereas it was noted in only 08% of Partial Hanging. These results are deviating from those of Sharma B.R. *et al.* [13], wherein he observed 54% of his cases confirming injury to the Sternocleidomastoid, however the results of his study did not indicate the type of Hanging responsible for it. A Transverse Tear in of internal Carotid Artery was reported in 67.27% of Cases of Complete Hanging, but the same changes were observed in only 3.6% of cases of Partial Hanging. This is possible due to the Perpendicular pressure and Stretching and Squeezing constricting Force as a result of Weight of the Body acting on the Internal carotid vessels, this results are contrary to the Claims made by Sharija Jayaprakash & Kuttikatti Sreekumari [10], who reported Carotid Intimal tear in only 1.1% of the cases. Capsular and Parenchymal Hemorrhages were noted in Thyroid Gland and Parotid Gland in 68% & 38% of Complete Hanging Respectively whereas it was only seen in 08% & 02% of Partial Hanging. The Thyroid Cartilage, Cricoid Cartilage and Hyoid Bone showed No Damage in partial Hanging. In cases of Complete Hanging the Thyroid Cartilage, Cricoid Cartilage, Hyoid Bone & Cervical Vertebra were found to be damaged in only 06%, 01%, & 04% respectively, whereas there were no damage reported to Trachea. This results are contrary to those made by Lenka Zátopková *et al.* [16], wherein he had reported laryngohyoid fractures in 129 of 178 cases (72.5%): isolated fracture(s) to the thyroid cartilage in 60 cases (33.7%), combined thyrohyoid fractures in 41 cases (23.0%), isolated fracture(s) to the hyoid bone in 28 cases (15.7%), and no fractures to the cricoid cartilage or the cervical vertebrae. Statistical analysis revealed significant associations of the occurrence of laryngohyoid fractures with the age of the victim, with the position of the ligature knot on the neck and with the age-corrected weight of the victim. Hence More Detailed Research is required along with Type of hanging and position of Knot. However, the results in the present study are close to that of the Study conducted by Sharija Jayaprakash & Kuttikatti Sreekumari [10], who reported in his study the Fracture of hyoid bone at their greater horns in 2.7% and thyroid cartilage in 5.3% of cases. Vertebral fracture and dislocation were noted between third and fourth cervical vertebrae in 1.6% of cases.

In the Present Study Cervical Spine Injury was noted in only 4% of cases of Complete Hanging and the same were unseen in Partial Hanging, this observations are close to those made by Slobodan Nikolić & Vladimir Zivković [17] wherein he had reported Cervical spine injuries in 25 of the 766 cases, In 16 of these 25 cases, the ligature knot was in the anterior position whereas in the Present study in 5% of cases the Knot was in Anterior Position or Front of the Neck. Hence, in the present Study, the External Findings of Face, Neck & Internal Examination Findings of Neck specific to Complete and Partial Hangings made us to Understand the Suicidal Hangings better. The Analysis and Comparison of the Results added more meaning to the Study.

## CONCLUSION

- The Skin over the Ligature Mark, the Obliquity of the Ligature Mark and the Facial Changes like Dribbling of Saliva, Congestion and Haemorrhages are peculiar to the Type of Hanging. Though there are Variations as to the Type of Hanging.
- The position of the Knot and type of Knot determine the Complete and Partial Nature of hanging besides the Suicidal Nature of Hanging.
- Structural Damage to Neck is very important to Understand, in all cases of Suicidal Hanging.

**Ethical clearance-** The Ethical Clearance was taken from Institutional Ethical Committee and they had cleared with a comment that it was Postmortem Study and No Clinical Trials was attempted.

**Source of funding-** Self Funding

**Conflict of Interest -** NIL

## REFERENCES

- K Modi's Medical Jurisprudence and Toxicology, 25th edition. Lexis Nexis, Reed Elsevier India. Gurgaon, Haryana. DEATHS FROM ASPHYXIA. 2016; pp 475.
- Iqbal, Mohammed (2018-12-29). "The dark side of Kota's dream chasers". The Hindu. ISSN 0971-751X. Retrieved 2020-10-13.
- Nikolic S, Micic J, Atanasijevic T, *et al.* Analysis of Neck injuries in Hanging. *Am J of Forensic Med & pathol.* 2003; 24(2):179-182.
- Sivasuthan S. Sternomastoid Rupture an index of antemortem hanging- an autopsy study of 100 caes, *Indian Internet JI of Forensic Med. & Toxicol*, 2005; 3(4).
- Abd-Elwahab Hassan D, Ghaleb SS, Kotb H *et al.* Suicidal hanging in Kuwait: retrospective analysis of cases from 2010 to 2012. *J Forensic Legal Med* 2013; 20(8):1118-21.
- Kumar S, Verma A. A study of elderly unnatural deaths in medico-legal autopsies at Lucknow locality. *Med Sci Law* 2013 Oct 28.
- Dean DE, Kohler LJ, Sterbenz GC *et al.* Observed characteristics of suicidal hangings: an 11-year retrospective review. *J Forensic Sci* 2012; 57(5):1226-30.
- Md Zubaidur Rahman, Md Abdus Samad, Md Zubaidur Rahman *et al.* Suicide By Hanging: An Analysis Of 312 Cases. April 2017 DOI: 10.3329/kyamcj.v4i1.32255.
- Kurtulus A, Yonguc GN, Boz B *et al.* Anatomopathological findings in hangings: a retrospective autopsy study. *Med Sci Law* 2013; 53(2):80-4.
- Jayaprakash S, Sreekumari K. Pattern of injuries to neck structures in hanging-an autopsy study. *Am J Forensic Med Pathol* 2012; 33(4):395-9.
- Sumin ska-Ziemann B, Bloch-Bogusawska E. Hangings in the material of Department of Forensic Medicine, Nicolaus Copernicus University Collegium Medicum in Bydgoszcz, in the years 2000-2010. *Arch Med Sadowej Kryminol* 2013; 63(4):267-71.

12. Al Madni OM, Kharoshah MA, Zaki MK *et al.* Hanging deaths in Dammam, Kingdom of Saudi Arabia. *J Forensic Legal Med* 2010; 17(5):265–8.
13. Sharma BR, Harish D, Sharma A, Sharma S, Singh H. Injuries to neck structures in deaths due to constriction of neck, with a special reference to hanging. *J Forensic Legal Med* 2008; 15(5):298–305.
14. Saisudheer T, Nagaraja TV. A study of ligature mark in cases of hanging deaths. *Int J Pharm Biomed Sci* 2012; 3(3):80–4.
15. Pradhan A, Mandal BK, Tripathi CB. Hanging: nature of ligature material applied and type of hanging according to point of suspension. *Nepal Med Coll J* 2012; 14(2):103–6.
16. Lenka Zátopková, Martin Janík, Petra Urbanová *et al.* Laryngohyoid fractures in suicidal hanging: A prospective autopsy study with an updated review and critical appraisal. *Forensic Sci Int.* 2018; 290:70-84.
17. Nikolić S, Zivković V. Cervical spine injuries in suicidal hanging without a long-drop patterns and possible underlying mechanisms of injury: an autopsy study. *Forensic Sci Med Pathol.* 2014; 10(2):193-7.