International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Motor Cycle Chain Sprocket Injuries of the Hand - Patterns, Classification and their Management - A Tertiary Care Experience

Dr. Mohammed Nishar S[1], Dr. Saravanan R[2], Dr. Sathish Kumar K[3], Dr. Radhakrishnan GS[4], Dr. Sridevi S[5]

[1]Resident, Institute for Research and Rehabilitation of Hand and Department of Plastic Surgery, Government Stanley Medical College and Hospital, Chennai, Tamil Nadu, India

[2]Assistant Professor, Institute for Research and Rehabilitation of Hand and Department of Plastic Surgery, Government Stanley Medical College and Hospital, Chennai, Tamil Nadu, India

[3]Assistant Professor, Institute for Research and Rehabilitation of Hand and Department of Plastic Surgery, Government Stanley Medical College and Hospital, Chennai, Tamil Nadu, India

[4]Professor, Institute for Research and Rehabilitation of Hand and Department of Plastic Surgery, Government Stanley Medical College and Hospital, Chennai, Tamil Nadu, India

[5]Professor, Institute for Research and Rehabilitation of Hand and Department of Plastic Surgery, Government Stanley Medical College and Hospital, Chennai, Tamil Nadu, India

Abstract: ***Introduction: Motor cycle chain sprocket injuries are common in frequency but has serious impact on the patients work capacity and daily activities. These type of hand injuries occur during cleaning or lubricating the motor cycle chain with the engine turned on. As a result, the fingers that get stuck undergoes serious injuries and most of the time amputation of the fingers occur. Aim: The aim of the present study is to analyse the characteristics of motorcycle chain injuries, & management. Materials and method: All patients who sustained chain sprocket injuries and treated at our institute between June 2022 and May 2023 (1 year) were taken for study. Totally 177 patients were included. All age groups and both the gender included. Data like age, gender, experience, hand dominance, injury patterns, treatment given, time taken to return to work were analysed. Results: Among 177 patients, 174 (98 %) were male. 51% of patients were between 21 to 30 years of age. Right hand injured in 127 patients (72%) and left hand in 50 patients (28 %). In our study, thumb is the most commonly injured finger 37%, followed by index finger 34%. Conclusion: Chain sprocket injuries cause serious trauma to fingers. Awareness among public should be made regarding the danger of chain sprocket injuries and importance of prevention of this type of injuries should be emphasized.***

Keywords: motorcycle chain injuries, hand injuries, finger amputation, injury prevention, trauma awareness

1. Introduction

Hand injuries cause major morbidity and impact on economy of the patient [1]. Chain sprocket injuries occur during cleaning or lubricating the motor cycle chain with the engine turned on and with fingers wrapped around with cloth. Accidentally this cloth can get pulled by the chain sprocket and the fingers get stuck and crushed between the chain and the sprocket. As a result there occurs severe crushing and contamination of the fingers.

Due to the severity of the crush along with contamination by the lubricant oil and dirt, the right and timely management of such injuries are crucial to reduce the morbidity as well as to improve the functional outcome of the hand involved. There are only a very few articles in the literature regarding chain sprocket injuries. Here in our study, we have done a detailed analysis of a number of motor cycle chain sprocket injuries and have attempted to provide a new classification system for chain sprocket injuries based on the soft tissue injury and the level of amputation.

2. Methodology

All patients who were treated for motor cycle chain sprocket hand injuries at our institute for a period of one year between June 2022 and May 2023 were taken for study. Totally 177 patients were included in our study. All age groups and both the gender were included. Data like age, gender, hand dominance, injury patterns, time of presentation, treatment given and time taken to return to work were analysed.

In case of total amputation and distal part brought by the attenders, bench dissection of all the distal parts were done in operation theatre.

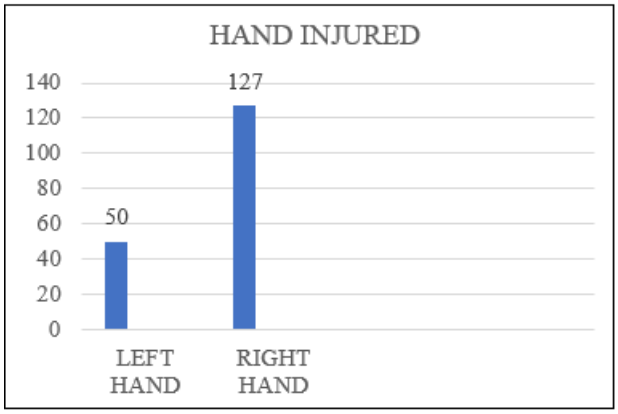
3. Results

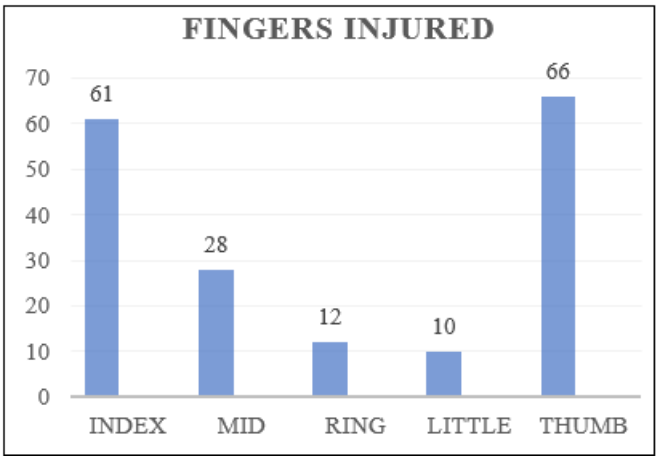
Among 177 patients studied, 174 (98%) were male.51% of patients were between 21 to 30 years of age.131 patients (74%) were non mechanics.82% of injuries has occurred at home.99 % of the patients studied were right hand dominant. Injury to the Right hand was seen in 127 patients (72%) and to the left hand in 50 patients (28%). Among the fingers injured, thumb and index finger were seen to be injured the most.51% of patients reached hospital between 1 to 3 hours

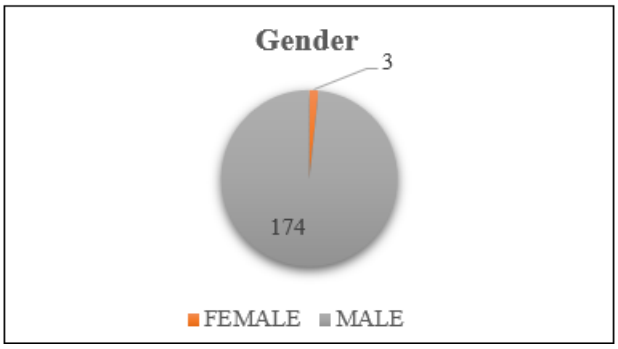
and rest after that. X - ray of the hand showed terminal phalanx fracture in 126 patients (71%), middle phalanx fracture in 22 patients (12%), proximal phalanx fracture in 7 patients (4%). No bony injury was noted in 21 patients (21%).124 patients (70%) were operated with digital block, 36 patients (20%) under axillary block and 7 patients under wrist block.

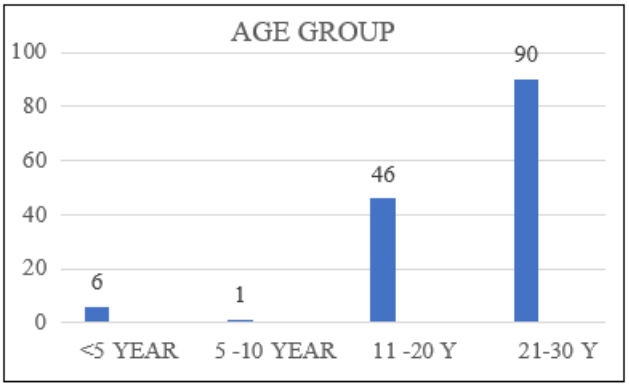
Among 177 patients, 118 patients (67%) had total amputation of fingers and 46 patients (26%) had partial amputation. No amputation was seen in 13 patients (7%). Among these 118 patients with total amputations, only 36 patients brought the distal amputated part with them to the hospital.82 patients were not able to bring the amputated part as it was severely crushed by the chain sprocket. The amputated stumps brought by the patients were dissected in the operation theatre under microscope. All the distal parts were seen to have crushed digital neurovascular structures and skin and soft tissue was severely contaminated with lubricating oil and dirt. An overview of the various procedures that were done are given in table 1.

Among 177 patients, 55% were able to return to work after 3 to 6 weeks.155 patients (88%) cleaned the bike chain with their engine turned on.145 patients (82%) used cloth to clean the chain which stuck in the chain sprocket.









Treatment given: Table 1

Procedures Done	No. of Patients
Brunelli flap	2
Cross finger flap	7
Conservative	5
First dorsal metacarpal artery	2
Furlow flap	1
Groin flap	2
Moschalla flap	1
Nerve repair	1
ORIF	1
Pivot flap	1
Skin suturing	36
Reverse flow thenar flap	1
Prof RV Oblique triangular flap	10
Replantation	9
Shortening and closure	70
Split skin graft	2
Tendon repair	1
Atasoy volar VY advancement flap	24

Table 2: Time taken to return to work

Time period (week)	No of patients
< 1 WK	3
>6 WK	13
1 - 3 WK	64
3 - 6 WK	97

Table 3: Cloth used for cleaning

Cloth for cleaning	No of patients
NO	32
YES	145

Table 4: Finger amputations

Type	No of patients
No amputation	13
Partial amputation	46
Total amputation	118

Image 1: child sustained chain sprocket injury with total amputation of index, mid, ring, little finger at ppx level. Distal part dissection showed crushed digital NV pedicles with loss. Groin flap given to cover the defect

Image 2: young adult male with total amputation of index, mid, ring. NV pedicles avulsed with loss and gross contamination present. Groin flap done to preserve the finger length

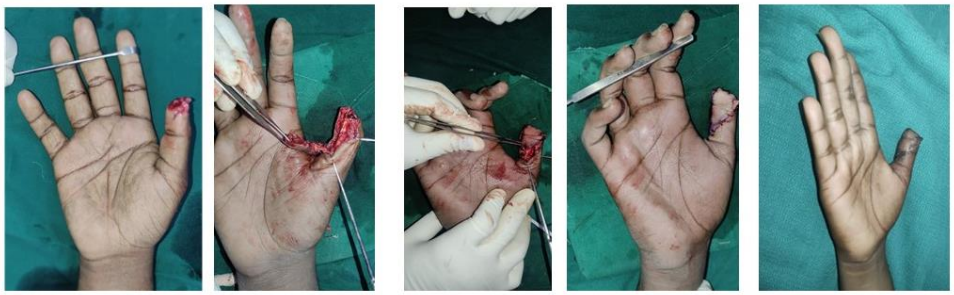


Image 3: Total amputation thumb at tip level. Prof RV oblique triangular flap done

Image 4: index finger total amputation with total loss of nail complex. Distal part not brought. Shortening and closure of index done

Image 5: Patient sustained injury to three fingers with gross contamination with lubricant oil. Total amputation of the mid and ring finger at tpx level. Shortening of mid finger and Prof R V Oblique triangular flap of the ring finger done

Image 6: Total amputation of thumb tpx. cross finger flap done from index finger.

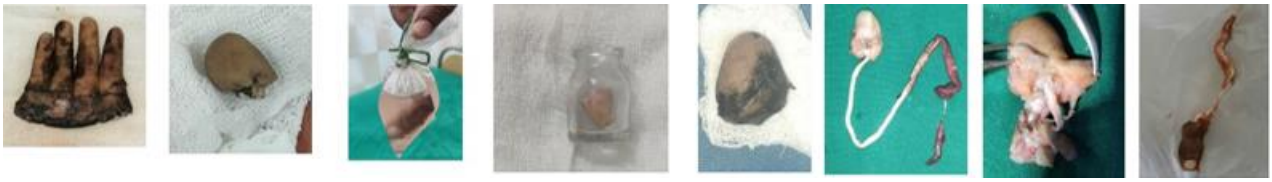


Image 7: shows distal part severely crushed and contaminated with lubricating oil and poor preservation of the distal part

Image 8: Replantation of thumb

4. Discussion

In recent times, there is an increase in frequency of hand injuries associated with motor cycle chain. There are only a very few articles in the literature that are related to chain sprocket injuries. Ishikawa et al [2] first published motor cycle chain sprocket injuries in a series consisting of 9 patients in the year 1991. A recent two year study done by Gokhan Karahan et al [3] from Turkey states chain sprocket injuries as uncommon injuries of the hand. But in our study we have reported 177 patients with motor cycle chain hand injuries in a period of one year duration signifying the increased frequency of such injuries in India.

Image 9. shows cleaning the bike chain with bare hands and also with cloth wrapped around the fingers. While cleaning the chain, the cloth over the finger can get caught by the chain and brought to the gear of the rear wheel resulting in crush injury. Most of the time digit would be cut off between the chain and the gear.

There are a number of fingertip injury classification systems available but none of them includes the information regarding volar oblique, dorsal oblique, and avulsion type of amputations. In instances like motorcycle chain injuries, we have observed that the injured fingers undergo different patterns of injury like crush injury, partial amputation, total amputation (transverse, dorsal oblique, volar oblique, ulnar oblique, radial oblique).

Present classification system for fingertip injuries available in the literature do not include these injury mechanisms and hence fall short in aiding the treatment direction. To overcome this, we have attempted to formulate a new classification system for chain sprocket hand injuries by combining the type of injuries and the status of the amputated finger.

Classification of Chain Sprocket Injuries:

CLASS 1	Crush injury without soft tissue loss
CLASS 2	Crush injury with soft tissue loss
CLASS 3	Partial amputation.
CLASS 4	Total amputation: Distal part NOT available
CLASS 5	Total amputation: Distal part available

Class 1:
Crash Injury without soft tissue loss

Management
- Conservative
- Skin Suturing

Class 2:
Crash Injury with soft tissue loss

Management
- Homodigital Flap
- Heterodigital Flap
- Split Skin Graft

Class 3:
Partial Amputation: Amputated part partly attached to finger

Management
- Skin Suturing
- Homodigital Flap
- Shortening Closure
- Revascularisation

Replantation of the amputated part can be done [4], [5] but is often difficult and unsuccessful because of severe soft tissue crush with loss, long segment macroscopic and microscopic vascular injury from crushing and shearing. In most of the cases the amputated digit is severely contaminated with lubricating oil. Moreover people often bring the amputated distal part in poorly preserved manner like direct contact with ice, immersing in the cold water, wrapping the finger in plastic cover which makes them unsuitable for replant

Class 4:
Total Amputation: Distal part not Available/ Viable
a) Dorsal Oblique amputation
b) Volar Oblique amputation
c) Radial Oblique amputation
d) Ulnar Oblique amputation
e) Transverse amputation

Management
- Homodigital Flap
- Heterodigital Flap
- Distant Flap
- Shortening Closure

Class 5:
Total Amputation: Distal part Available

Management
- Replantation

5. Conclusion

Chain sprocket injuries cause severe harm to hand and has serious impact on the patients work capacity and daily life. Classification provided will aid in the surgical management. Considering the severity and the rising frequency of such injuries in India, it is recommended to create caution among the public regarding the danger associated with cleaning the motor cycle chain. There should also be awareness and education given regarding the ways to avoid such injuries. Public should also be educated about the proper technique of preservation of distal part while they are bringing it to the hospital. Two-wheeler manufacturing companies should be instructed to modify their models so that bike chains are fully covered thus preseventing such hand injuries.

References

[1] Hoxie SC, Capo JA, Dennison DG, Shin AY. "The economic impact of electric saw injuries to the hand". J Hand Surg Am 2009; 34: 886–9, http: //dx. doi. org/10.1016/j. jhsa.2009.02.002

[2] Ishikawa K, Yoshida, Isshiki N, Soeda H, Otsuka M. "Replantation of the digits amputated by motorcycle chain injury". Eur J Plast Surg 1991; 14: 132–6, http: //dx. doi. org/10.1007/BF02341738.

[3] An uncommon injury: Motorcycle chain injury of the hand, its socioeconomic outcome, and prevention. Gokhan Karahana, ∗, Kamil Yamaka, Mesut Demirkoparanb, Taskin Altaya, Levent Kucuk. https: //doi. org/10.1016/j. otsr.2020.102800

[4] Yamano Y (1985) Replantation of the amputated distal part of the fingers. J Hand Surg 10A: 211

[5] Ishikawa K, Ogawa Y, Soeda H, Yoshida Y (1990) A new classification of the amputated level for the distal part of the finger. J Jpn Soc Reconstr Microsurg 3: 54