

## Soft tissue management at a level I trauma centre in urban India: 5 years' experience

### Key words:

- Debridement
- Soft tissue injury
- Trauma centre
- Wound infection

Soft tissue injuries (STIs) have a high incidence in trauma patients; however, literature available on this is limited. Data was acquired retrospectively from January 2015 to December 2019 from a level I trauma center in urban India. A total of 89,929 patients with STIs required intervention in the emergency department (ED). Out of 7349 inpatients, 3620 required intervention for STIs. Overall, 1750 patients required debridement, 1056 split-thickness skin grafts, 594 debridement with skin grafts, 209 flaps, 10 tissue expanders and 1 cadaveric skin transplant was done. 806 patients required amputation. 14 patients with STIs had mortality. A dedicated wound management team is the need of the hour in trauma centres.

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Road traffic incidents are a growing and major health problem in the world. According to the World Health Organization, road traffic incidents are to become the fifth leading cause of death by 2030 (Curry et al, 2011). India, with only 1% of the world's vehicles, still accounts for 10% of road traffic incidents (Curry et al, 2011) and more than 1.3 lakhs victims die every year as a result, which tops the list of the world (Gopalakrishnan, 2012). The case fatality rate in India is 14% compared with China who has a case fatality rate of 5% with twice the number of registered vehicles (Mohan et al, 2015). There are 90% of disability-adjusted life years lost due to road traffic accidents (Dalal et al, 2013), which is true for developing countries and India is no exception. There has been an increase of road traffic incidents by 43% in India, with India overtaking China on the number of accidents and fatalities. More than 50% of these road traffic incidents happen in urban India. Males in the working age group of 30–39 are more vulnerable to road traffic incidents, which is important as they contribute to the economy of the country. Most of the victims are poor as they are mostly pedestrians, motorcyclists and people who travel by means that are prone to accidents. Most of the disability is also borne by poor people due to their injury kinematics; 28% of all disability is due to road traffic incidents (Curry et al, 2011). Nearly 40% of these are due to soft tissue injuries (STIs), which comprise the majority of injuries treated in a trauma centre (Kretlow et al, 2010). STIs occur mostly in the limbs, head

and neck region (Pandey et al, 2015) and range from a laceration to a degloving and crush injury. Treatment of STIs should be tailor-made and has many dimensions. Despite a high incidence of STIs, limited literature is available regarding their management and outcomes. Hence, in this study, we retrospectively reviewed the frequency, treatment and various aspects of management for STIs at the Jai Prakash Narayan Apex trauma center, a level I trauma center in urban India.

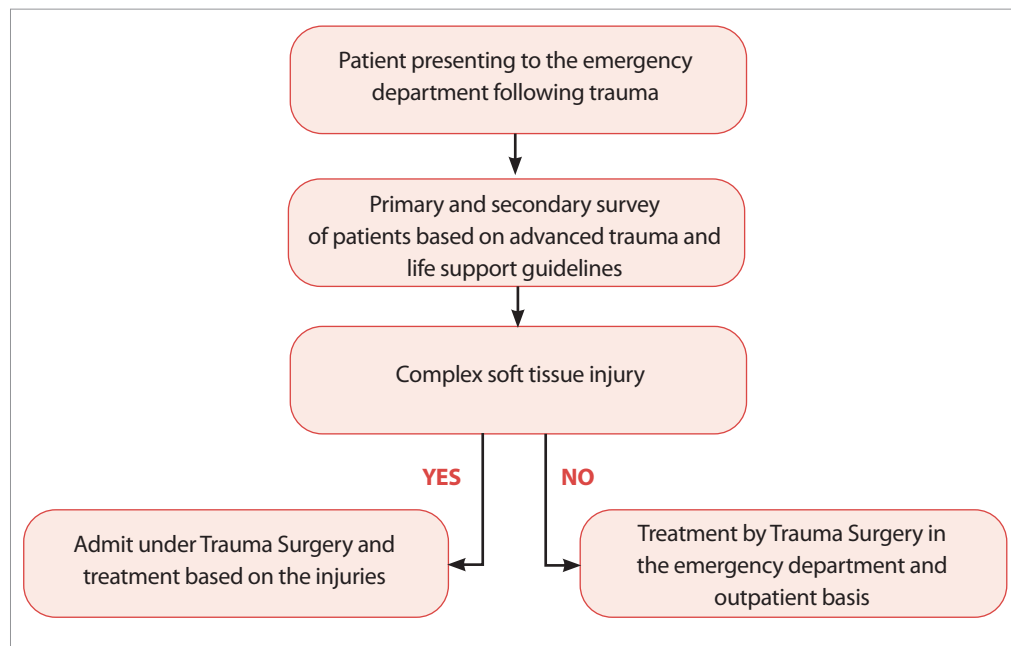
### Methods and patients

This study was conducted in Jai Prakash Narayan Apex Trauma Center, a level I trauma center in urban India. Data were acquired retrospectively from the central database of the centre from January 2015 to December 2019 from the patients who were admitted or treated under trauma surgery. All patients were evaluated by a surgical specialist in the emergency department (ED) as per advanced trauma and life support protocols. Once a patient is diagnosed with a soft tissue injury, they are treated based on the extent of injury, with treatments such as suturing in the ED. If higher forms of intervention are required then they are admitted under the care of trauma surgeons. The critical pathway followed for patients in our ED is based on Advanced Trauma and Life Support (ATLS) guidelines, which is the standard of care across the world (Figure 1). Patients admitted under orthopaedics, neurosurgery, were dead on arrival and patients who visited the outpatient department (OPD) as a referral from other

**Figure 1.** Critical pathway followed in Emergency Department for patients with soft tissue injuries (STIs)

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centres were excluded from this study.

### Statistical analysis

Data were analysed and expressed as proportions, mean or median as required. SPSS 18 was used for statistical analysis. As this was a descriptive analysis pictorial representation was also given.

### Results

A total of 333,123 patients visited the trauma centre in five years with an average of 66,625 patients per year. The pattern of STIs that require intervention ranges from a simple laceration to complex degloving and crush injuries. Of these patients, 89,929 required intervention in the ED

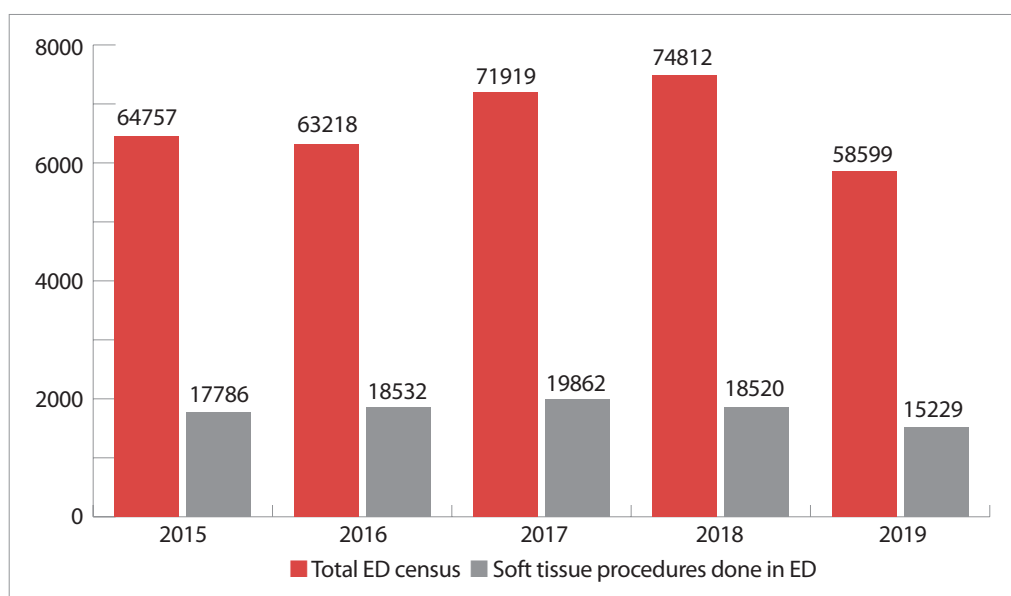
for STIs, with an average of 17,986 patients per year. This comprises of 26.9% of patients who visit the ED (Figure 2).

There were 7349 patients who required admission for treatment under trauma surgery, with an average of 1470 admissions per year (Figure 3). Of these, 6482 (88.2%) were male and 867 (11.8%) were female, while 515 (7%) belonged to the paediatric age group.

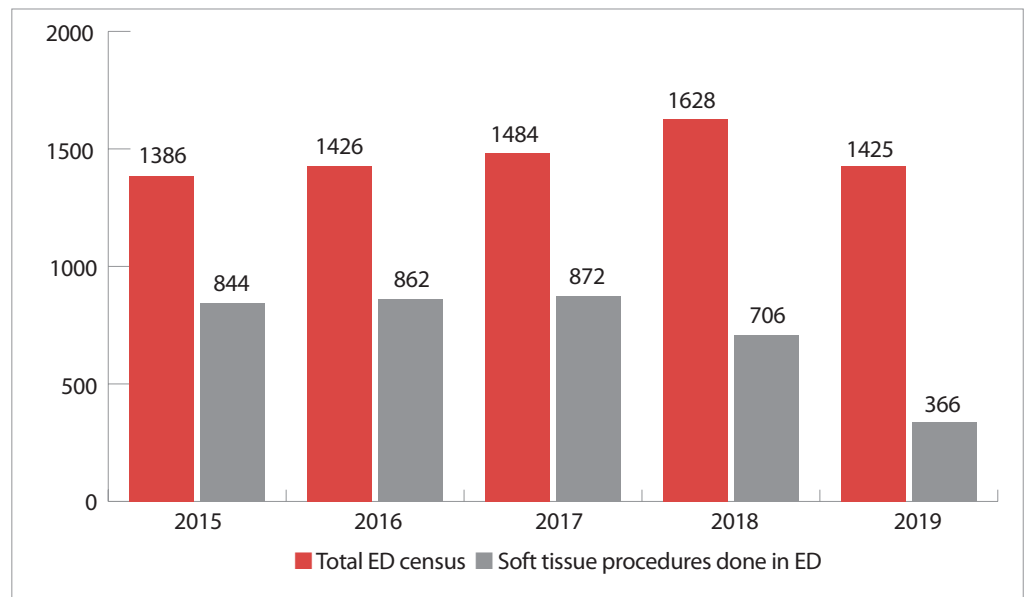
Of these total inpatients, 3620 (49.25%) required intervention for STIs, with an average of 724 patients per year.

A total of 1751 (48.4%) required debridement, 1056 (29.2%) split-thickness skin grafts (STSG), 594 (16.40%) debridement with skin grafts, 209 (5.77%) flaps and 10 (0.27%) tissue expanders

**Figure 2.** Yearly data of patients visiting emergency department (ED) and who underwent procedure for soft tissue injuries in ED



**Figure 3.** Comparison of inpatients and the inpatients with soft tissue injuries (yearly data)



**Table 1.** Different soft tissue procedures done in the last 5 years (Year wise data)

	STSG*	Debridement	Debridement+STSG*	Flap	Tissue expanders
2015	312	361	125	46	0
2016	265	368	129	96	0
2017	239	468	129	31	5
2018	162	368	153	16	5
2019	78	186	58	14	0

\*Split-thickness skin graft

**Table 2.** Breakdown of procedures done over five years

Procedures	Numbers
STSG*	1056
Debridement	1751
Debridement and STSG*	594
Flap	209
Tissue expanders	10
Cadaveric skin transplant	01

\*Split-thickness skin graft

**Table 3.** Mortality over 5 years among patients with STI

	Numbers
Total inpatients	7349
Total inpatients with STI	3620
Total mortality due to STI	14

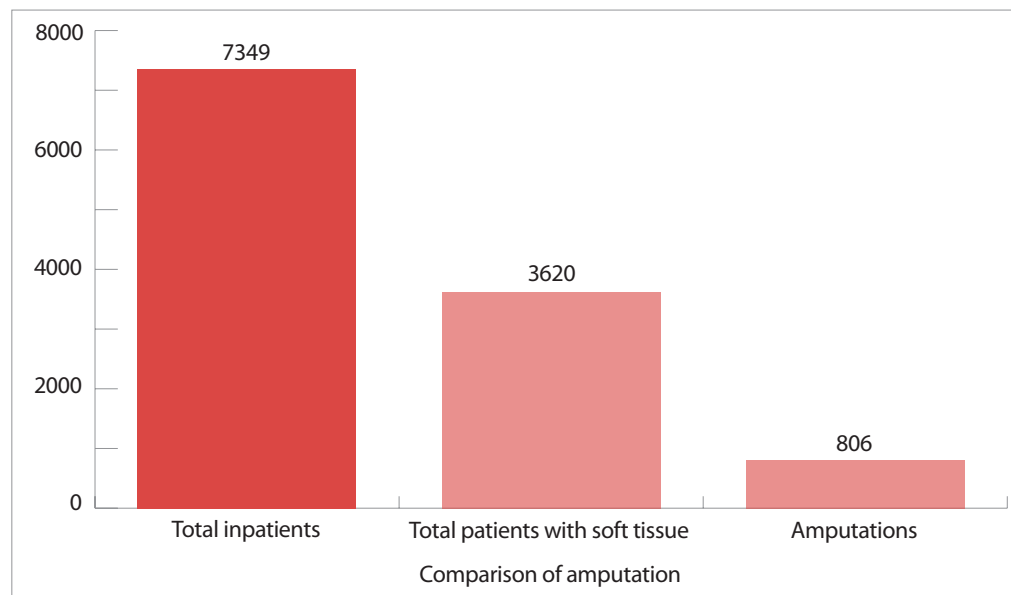
done in the last five years (**Table 1 and 2**). There was one cadaveric skin transplant done.

There were 806 patients with STIs requiring amputation during their course of treatment, this forms 22.26% of patients with STIs and

10.96% of inpatients (**Figure 4**).

Negative pressure wound therapy (NPWT) was used in 248 patients (6.85%) and 108 (2.46%) patients underwent hyperbaric oxygen therapy (HBOT).

**Figure 4.** Amputations in soft tissue infections over five years



There were 14 patients who died due to STIs and its complications. The mortality rate is 0.38 among patients with STIs and 0.19 among total inpatients (*Table 3*).

### Discussion

There were 3,33,123 patients who visited the trauma centre in five years, with an average of 66,625 patients visiting the hospital due to trauma. This is the highest total patient volume compared with other published sources at a level I trauma centre. Level I trauma centres around the world cater to approximately 35,000 in the Netherlands, 40,000 in Australia and approximately 19,000 in USA in 2012 (Choi et al, 2021).

Despite a high hospital load, our inpatient volume is only 1470 patients per year. This is higher than other level I trauma centers in developed countries where there are approximately 1300 admissions per year (Ovadia et al, 2000). Differences in the number of patients attending the ED compared with inpatients volume at our centre is explained by the fact that a significant number of trauma victims have trivial low-velocity injury, which can be managed in the ED itself without admission.

Only patients with major injuries are admitted for further management because there is no proper triage protocol or EMS services in India and, therefore, all patients with trauma attend our hospital for treatment despite the level of injury (Joshipura et al, 2003). This is in direct contrast to the inpatient volume in non-urban India where there are only 300 patients per year (Joshipura, 2008).

There are 26.9% or 7986 patients per year treated for STIs in the ED for trivial STIs. This comprises of 26.9% of patients who visit the ED. In published studies, the incidence of STIs is only 4% (Hakim et al, 2016). As previously mentioned, these high numbers are because we also cater to level II and level III trauma victims.

Though there is no consensus on the gender difference in road traffic accidents, the number of male victims remains higher at 6482 (88.20%), with only 867 (11.80%) females. Mortality is also high in males, most likely because of the higher incidence of injury (Chandrasekharan et al, 2016). Our results show similar findings and may be due to the fact males are involved in outdoor activities and vehicle use is far greater than their female counterparts. Despite this, the number of female victims are on the rise due to the evolving trend in access to vehicles (Suphanchaimat et al, 2019).

There were 515 (7%) patients in the pediatric age group, this is higher than the average of 4.2% in the developed world (Lee et al, 2018). The problem appears to be multifactorial. Firstly, there is no parental guidance on vehicle access for a child and, even with supervision, children are more prone to injuries as the traffic in India is so disorganised (Pal et al, 2019).

In our study, the incidence of STIs among patients requiring intervention as inpatients was 49.25%. Though STIs are the most common injuries following RTI and trauma, the incidence reported ranges from 20–27% for isolated STIs (Hakim et al, 2016). Higher incidence in our setting is probably due to the different injury kinematics, mostly being low-velocity isolated injuries requiring interventions.

There were 48.37% of patients who required debridement as a primary operation who had STSG later. In the last five years, a total of 1750 (48.37%) required debridement, 1056 (29.17%) STSG, 594 (16.40%) debridement with skin grafts, 209 (5.77%) flaps and 10 (0.27%) tissue expanders. There was one cadaveric skin transplant done. Patients also had multiple operations before being discharged. All patients receive definitive operations for wound cover. Single debridement is beneficial when done properly to multiple debridement (Manna et al, 2020). We debride according to the contamination and if presented early we also do STSG at the same setting. When the bone is exposed, we do rotational or free flaps; we have also done tissue expanders for scalp wounds post-scar formation. We had one cadaveric donor transplant but these are not carried out often due to the cost constraints.

There were 10.96% of patients who needed amputation for a non-salvageable limb. We assessed patients with the Ganga Hospital Score (GHS) and Mangled Extremity Severity Score (MESS) but decided on amputation as per clinical assessment. Some patients underwent amputation after initial operation for salvage, which is similar to other centers where amputation rates were described in the range of 10-20% (Kobayashi et al, 2011; Clasper and Ramasamy, 2013). Even fewer amputation rates (0.2% to 2%) were described in developed countries, which may be due to better road safety interventions (18).

NPWT was used in 248 patients (6.85%), 108 (2.46%) patients underwent HBOT. Both therapies were only introduced in the last 3 years. NPWT has been proven to improve wound healing and HBOT is particularly beneficial for ischaemic wounds (Kirby, 2019). We use a custom-made and proprietary NPWT system.

There were only 14 mortalities due to STIs in the 5 years, accounting for 0.38% of the total patients admitted. Literature has reported a mortality rate of 2–8% due to soft tissue management (Chandrasekharan et al, 2016); one study reported a mortality rate of 3.8% (Borowy, 2013). Our low rates are due to our team approach and holistic care for definitive treatment.

A team approach is recommended as it helps with early identification of wound-related problems and determining how to address these. Our team comprises of clinicians, wound manager nurses, social workers and a physiotherapist. Each has a specific role, which helps to improve outcomes for the patient. Wound managers help in daily dressings and

early identification of infections, graft loss and inpatient counselling. They also help in pressure ulcer management and outpatient management of wounds. They provide counselling and education on wound management in the outpatient department.

Our in-house physiotherapist helps with early mobilisation and exercises, leading to better patient outcomes. They help in stump management after amputation and rigorous follow-up of patients for early prosthesis support.

Most of our patients are from poor backgrounds and need help financially. The social worker helps in identifying these deficits and in funding and bridging the financial gap, thus completing the loop of holistic care (Raju et al, 2016). They also help in the transfer of destitute patients to level II and level III nursing home for further care. This teamwork with a holistic approach is what gives us better results and we recommend the same.

## Conclusion

STIs are the most common injuries after trauma. Despite the high incidence, the knowledge and treatment protocols are not well established. We suggest that a dedicated wound management team is the need of the hour for management of STIs in trauma centers. This helps in complete understanding of the wound, its treatment and provides a holistic approach to patient care. **WAS**

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