Spine fractures caused by suicide jumping and the influence of COVID pandemic

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Research

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Abstract

Background. Suicide is a major problem worldwide, and jumping from a height is a common suicide method in Europe and Germany. This method primarily results in severe spinal fractures. As a maximum-care hospital in Berlin, we observed an increase in severe spine fractures due to suicidal jumping.

Objective. To describe the characteristics of these fractures in suicidal jumpers compared to non-suicidal individuals and analyse their association with the COVID-pandemic.

Method. We extracted the chart data of patients who suffered severe spine fractures (from thoracic vertebra 1 to lumbar vertebra 5) due to trauma and who were treated surgically in our centre between 01 January 2015 and 31 May 2021.

Results. Seventy-one patients were included in the study. Suicidal jumpers were about 11 years younger ($p = 0.008$) and more likely to be female (relative risk= 1.3, $p = 0.47$). The two groups differed in their initial haemoglobin values (mean difference= two g/dl, $p <0.001$). The lumbar region was twice as affected in suicidal jumpers ($p = 0.02$). Before the COVID-lockdown within 63 months, there were 19 suicide cases and 38 non-suicidal cases. After COVID-lockdown within 14 months, 11 suicidal cases vs only three non-suicides resulted in a ratio of 2.57 (p-value<0.001). There were no significant differences in radiological and clinical outcomes.

Conclusions. Spine fractures in suicide jumpers differ from those in non-suicide jumpers in terms of age, initial haemoglobin level, and spine region. These fractures have increased significantly in Berlin since the COVID lockdown. Surgical treatment of these fractures provided the same results in both groups.

Feasibility And Pilot Study

This study aims to investigate a hypothetical association between COVID-pandemic and suicide spine injuries. It is a pilot and explorative study for testing hypothesis and to determine a sample size and to find the places of shortcomings in future similar studies.

Introduction

Suicide is a major problem worldwide and is the fourth leading cause of death [1, 2]. Different methods of suicide have been described, with jumping from a high place ranked in some countries as the first suicide method [3, 4]. There were more than 15 000 cases of jumping suicide in the German population between 2004–2005 [4]. The main and most drastic injury caused by suicide jumping is an injury to the spine, especially in the thoracic or lumbar region [1, 3, 5]. This type of injury is mainly caused by a fracture of one or more vertebrae. This injury can result in neurological disability, complicated by further psychosocial problems [6]. Since the COVID-pandemic, there have been concerns that social isolation and lockdown measurements negatively influence psychological and mental health, especially in the young population [7]. In Berlin, the city with the highest suicidal tendencies in Germany [8], this method of suicide could have increased since the COVID lockdown on 22 March 2020 as in other German-speaking countries [9].

Hence, the incidence of associated spine fractures could also have increased. These fractures' resulting medical, social, and economic burden is very high because most injuries occur in young adults, affecting their primary productive years [10]. Thus, the appropriate management of these injuries is of high priority. This type of suicidal injury has only been fully described in non-European populations or with an insufficient sample size in the medical literature [3, 5].

In the German population, the only report dated back to the last century, with no details about surgical treatment and follow-up outcomes [11].

As a maximum care hospital and a supra-regional trauma centre, we recently observed severe spine fractures due to suicidal jumps from great heights. Therefore, because of the rising concern regarding the deterioration of public mental health during the COVID pandemic, this study aimed to analyse its association with severe spine fractures caused by suicidal jumping and describe these patients in comparison with non-suicidal cases. This study also described the different surgical approaches and techniques applied to treat this type of injury using radiological, operative, and clinical outcomes.

Methods

Patients selection

We retrospectively reviewed the charts of all patients treated surgically in our supra-regional maximal care trauma centre, Vivantes Klinikum im Friedrichshain in Berlin, for traumatic spine fractures between 01 January 2015 and 31 May 2021. We used two ICD-10 codes (S22.0 and S32.0) to search for eligible patients in our database. The patients were included according to the following eligibility criteria:

1. The patient had a spine fracture at any vertebra, from the first thoracic (T1) to the last fifth lumbar (L5).
2. Only fractures were diagnosed after specified date of trauma (traffic accidents, falling from a height, or other types of acute traumatic injuries).
3. No age restriction was stated.
4. Only patients who were surgically treated either by dorsal stabilisation alone or with ventral augmentation in two different sessions (first dorsal and then augmented with ventral fusion) were included.
5. Patients with cervical and pathological fractures (due to tumour, osteoporosis, or metastasis) were excluded.

After searching for and including eligible patients, 14 data items related to baseline characteristics were extracted into an Excel spreadsheet, and all other data items were related to outcome measurement. Appendix I provides a complete list of data items and their descriptions.

Outcomes measurement

Two doctors independently assessed radiological outcomes. These consisted of the sagittal index (SI) measured using the method of Farcy [12], the loss of vertebral height index (LVH) estimated using the method of Keene [13]. Briefly, each doctor measured and evaluated the radiological outcomes in the computer topographies (CT) or X-rays of the patients independently and entered the measurements into the dataset blindly from another doctor. The SI was calculated as the absolute value of the angle of kyphotic deformity at the fractured motion segment level minus the normal contour values (5° in the thoracic, 0° at the thoracolumbar junction, and − 10° in the lumbar region) so that the SI of zero is the normal perfect alignment. Any deviation (either less or greater than zero) was entered as the absolute value to obtain a unified scale for all spinal regions [12]. Figure 1a shows an example of SI measurement. LVH was calculated as the ratio of the anterior height of the injured vertebrae to the mean anterior height of the two adjacent intact vertebrae. An LVH of 1 is the standard perfect height, and any value less than that is pathological. The lower limit of LVH was zero [13]. Figure 1b shows an example of an LVH measurement. Both SI and LVH were measured at four-time points: at baseline (in the initial CT or X-ray at presentation), after dorsal surgical treatment, after ventral fusion (if available), and then at follow-up with a minimum of 3 months.

The time of surgery was calculated in minutes and extracted electronically from the surgery documentation.

The pain was assessed using the visual analogue scale (from 0 = no pain to 10 = extreme pain) extracted from the chart documentation. The pain was also recorded at four-time points: at baseline, after dorsal stabilisation, after ventral fusion, and finally at the follow-up (at least three months). Complications were considered any postoperative complications related to surgical treatment, as documented in the patient's chart.

Patients' grouping

Comparisons related to the aetiology of the injury grouped the patients into two groups: patients with fractures due to suicide jumping and those with fractures due to all other causes (suicide jumpers vs non-suicide). According to the type of surgical approach used, there were the following groups: dorsal short-segment stabilisation (where only two vertebral segments were stabilised with pedicle screws), dorsal long-segment (where more than two vertebral segments were stabilised with pedicle screws), open dorsal stabilisation (where the placement of pedicle screws was through conventional open surgery), percutaneous dorsal stabilisation (where the placement of pedicle screws was through minimally invasive percutaneous surgery), dorsal stabilisation alone (any dorsal approach); and combined approach (dorsal stabilisation + ventral fusion) in two sessions.

Statistical analysis

Continuous variables were presented as mean ± standard deviation (SD) when normally distributed and median and interquartile range (IQR) when skewed. Binary variables are presented as numbers or percentages. We used the t-test or linear regression for continuous baseline characteristics and Fisher's exact test or logistic regression for binary variables. The SI, LVH, and pain analyses were conducted using mixed-effects regression modelling, suitable for analysing data with repeated measurements and missingness. The analyses were adjusted for the baseline values of the outcomes, and the mean SI and LVH values between the two doctors were used. A Poisson regression model was used to analyse misplaced pedicle screws and complications (both count data). The P-value was set at 0.05. All statistical calculations were performed using StataCorp software. 2020. Stata Statistical Software: Release 17. College Station, TX, StataCorp LLC.

Results

Demographic and baseline results

Under the used codes (ICD-10 S22.0 and S32.0), we identified 135 patients between 01 January 2015 and 31 May 2021. Sixty-four patients were ineligible (not traumatic fractures or non-surgically treated). Figure 2 shows the flow chart of the patients according to the cause of injury and surgical approach. Seventy-one patients (29 women vs 42 men) with a median age of 38 (IQR 16–72) were included. The median follow-up time was four months (IQR 3–17). Follow-up data were only available for 31 patients.

In comparing the cause of the injury, 30 suicide jumpers and 41 patients with non-suicidal genesis (falling, traffic accidents, and other trauma). Table 1 shows the demographic characteristics of the two groups with their differences.

There was no significant difference regarding gender; however, the female sex was more common in the suicide group with a relative risk of 1.3 (95% CI from 0.7 to 2, p-value = 0.47).

The suicidal group was 11 years younger, with a mean difference of 11 years (95% CI: 3–19 years; p = 0.008).

The lumbar region was affected twice as much in the suicidal group, with a relative risk of 2 (95% CI: 1.2 to 3.3, p-value = 0.02). The vertebrates L1 and T12 were the most affected in the whole cohort. Figure 3 shows the distribution of the fractures per vertebra.

Regarding fracture severity, we used the AO classification to group injuries. There were no significant differences in the fracture types; however, most of the included patients in the two groups had compression fractures of the A-type (A3 and A4).

Another statistically significant finding was the initial haemoglobin, 2 g / dl less in the suicidal group with 95% CI from 0.9 to 3 and p-value < 0.001.

The day of the injury also differed between the two groups, where more suicide cases were reported in the early morning hours (from 0 am to 7 am) (see Table 1). In contrast, more non-suicide cases were presented from the evening until night (from 5 pm to 0 am) (see Table 1).

Regarding the day of the injury, 24 suicide cases and 36 non-suicides were reported during the working days (from Monday to Friday). The rest were observed during the weekends (see Table 1).

Table 1: Baseline Characteristics in patients with spine injuries (suicide jumping vs non-suicide)

Variable	Suicide-jumper (N=30)	Non-suicide (N= 41)	Difference	95% CI	P-value
Age (mean±SD) in year	35 ± 17	46 ± 18	**11**	**3 – 19**	**0.008**
Sex (female/male)	14/16	15/26	1.3*	0.7 – 2	0.467
Region of injury					
Thoracic (n) Thoracolumbar (n) Lumbar (n)	3 16 11	12 24 5	0.4 0.9 **2**	0.1 – 1.1 0.5 – 1.5 **1.2 – 3.3**	0.08 0.08 **0.02**
AO Classification					
A (n) B (n) C (n)	26 2 2	37 4 0	0.8 0.8 6.8	0.4 – 1.8 0.2 – 2.5 0.3 – 1.4	0.714 1.000 0.211
Initial Hemoglobin (mean±SD) in g/dl	11.55 ± 2.6	13.55 ± 1.57	**2**	**0.9 – 3**	**< 0.001**
Number of injuries according to Daytime					
0 am till 7 am (n) 7 am till 5 pm (n) 5 pm till 0 am (n)	9 17 4	5 19 17	2.46 1.27 **0.37**	0.92 – 6.6 0.73 – 2.2 **0.15 – 0.92**	0.08 0.473 **0.017**
Number of injuries during Working days	24	36	1.36	0.73 – 2.54	0.51

***: relative risk of female to male**

Influence of the COVID-pandemic

Since the COVID lockdown, there has been an increase in spinal injuries caused by suicidal jumping. Before COVID (i.e. during 62.75 months from 01.01.2015 to 21.03.2020), there were 19 suicidal cases vs 38 non-suicidal cases. On the other hand, there were 11 suicidal cases vs only three non-suicide after COVID lockdown (i.e. during 14.25 months from 22.03.2020 till 31.05.2021); this resulted in a rate of 0.3 suicide case/month in the period before COVID lockdown vs a rate of 0.77 suicide case/month after the lockdown (see Fig. 4.). Correspondingly, a ratio of 2.57 indicates more than twice the increase in these injuries because of suicidal jumping after the COVID lockdown. However, to test this statistically, we compared the number of suicide cases to non-suicide cases after the lockdown to the same period in the previous five years (see Table 2). The results in Table 2 also confirmed the increased ratio of suicidal spine fractures to non-suicide with rate ratios of 2.55, 1.89, 2.75, 1.57,

and 2.2 in the same periods (from 22 March to 31 May) between 2015 and 2020. However, only comparisons with the first and last periods were statistically significant ($p < 0.05$).

Table 2

The rate of spine injuries in suicide jumpers to not-suicide patients in the lockdown period from 22.03.2020 till 31.05.2021 compared to the rate at the same periods in the previous four years. During the lockdown period, there were 11 suicide and three not-suicide

Time period	Number of patients (suicide/not-suicide)	Rate Ratio (Lockdown-period/previous period)	95% CI	P-value
22.03.2015 till 31.05.2016	4/9	**2.55**	**1.08–6.04**	**0.02**
22.03.2016 till 31.05.2017	5/7	1.89	0.90–3.89	0.11
31.05.2017 till 31.05.2018	2/5	2.75	0.83–9.16	0.06
22.03.2018 till 31.05.2019	6/6	1.57	0.84–2.95	0.22
22.03.2019 till 31.05.2020	5/9	**2.2**	**1.03–4.68**	**0.02**

Treatment approaches

As shown in Fig. 2, the combined approach was applied more frequently than dorsal stabilisation alone in the suicidal group (20 vs 10). In contrast, both approaches were applied almost equally in non-suicidal patients (19 vs 22). Patients who underwent a short-segment dorsal approach were more likely to undergo ventral fusion to complete a combined approach (27 short-segment vs 12 long-segment in the combined approach, and 16 short-segment vs 16 long-segment in the dorsal approach alone) with a relative risk of 1.47 (95% CI, 0.9 · 2.38, $p = 0.14$). Eleven patients underwent a percutaneous approach of dorsal stabilisation compared with 60 patients who underwent conventional open surgery. Most percutaneous surgeries were conducted in the later years of this study (2018).

Radiological outcomes

The baseline sagittal index dramatically improved (reduced to zero) in both groups (suicidal and non-suicidal). After ventral augmentation, a slight improvement was noted in achieving the combined approach. However, the follow-up measurement showed a deterioration (SI increased) in both groups, particularly in the non-suicidal group (see Fig. 5). The same trend of improvement after each surgical intervention and then deterioration at follow-up was noticed regarding loss of vertebral height in both groups (see Fig. 6). After adjusting for baseline values, we found no statistically or clinically significant differences by comparing these outcomes using the mixed-effects regression model between the two groups. However, there was a slight improvement in the two indices at follow-up, with a reduction of 2.77° in the SI ($p = 0.06$) and an increase of 0.08 °in LVH ($p = 0.07$) in the suicidal group compared to the non-suicidal group. Table 3 shows the differences between the radiological outcomes of the radiological outcomes in the mixed model.

Table 3
Mixed regression model for SI and LVH measured after adjustment to the baseline values

Timepoint	SI difference*	95% CI	P-value	LVH difference*	95% CI	P-value
After dorsal approach	0.5	-1.69 to 2.68	0.65	0.008	-0.06 to 0.07	0.82
After combined approach	-1.19	-3.93 to 1.55	0.40	0.04	-0.04 to 0.13	0.33
At the follow-up	-2.77	-5.70 to 0.16	0.06	0.08	-0.007 to 0.18	0.07
*: mean value in suicidal group minus non−suicidal						

Operative time

The surgery time was longer in the suicidal group (184 Â ± 13 minutes) than in the non-suicidal group (152 Â ± 8.7 min), with a mean difference (MD) of 32 minutes (95% CI, 1.8 to 62; p = 0.04).

Clinical outcomes

At follow-up, six patients in the suicidal group manifested neurological deficits, including paraparesis, compared with seven patients in the non-suicidal group (p = 0.77). There were four postoperative complications in the suicidal group compared to eight in the non-suicidal group (p = 0.53). Only one death occurred in the non-suicidal group due to postoperative sepsis.

Pain mainly improved after the dorsal approach in both groups. However, the pain increased slightly after the combined approach in both groups, which was explained by the new operative incision to conduct the ventral fusion (see Fig. 7). At follow-up, the difference in pain was non-significant between the two groups, with one degree less in the non-suicidal group, as shown in the mixed-effects regression models with a mean difference of 1.24 (p-value = 0.34).

Discussion

This study is the first to describe and analyse the characteristics of spine injuries after suicidal jumping compared to non-suicidal individuals and the influence of COVID-pandemic in a cohort of 71 patients in Berlin. We found a significant increase in severe spine fractures caused by suicidal jumping since Berlin's COVID lockdown in March 2020. Other reports have confirmed increased psychiatric disorders and suicidality since the COVID-pandemic, especially in the young population in Berlin [7]. In another report from Austria, the researchers found a significantly higher percentage of patients admitted to the resuscitation room of the Level 1 Trauma Center during the lockdown. The latter sustained their injuries due to a suicide attempt compared to the same 2-month period in the previous four years [9]. This result confirmed a significant increase in spine trauma fractures caused by a suicide attempt since the COVID lockdown compared to the previous periods in the last five years. However, we should mention that this increase accompanied a decrease in non-suicidal traumatic injuries, contributing to the observed increased ratio of suicide to non-suicide fractures. This reduction in non-suicidal traumatic spine injuries was also observed in the UK during the first national lockdown [14].

Patients with spinal fractures due to suicidal jumping were younger than those with non-suicidal behaviours. This finding was observed in previous case series [1, 5]. Kano reviewed a cohort of 87 suicidal jumpers compared to 205 non-suicidal individuals and found that suicidal jumpers were ten years younger than non-suicidal [5]. In Kennedy's case series of 137 patients, the mean age was 32 years, approximately the same age as that found in our study (35 years) [1].

Spine fractures due to suicidal jumping are more likely to occur in women in Berlin. This finding confirms the European Alliance Against Depression report; wherein women were 1.8 more likely to experience suicidal jumping in Germany between 2004 and 2005 [4].

Spine fractures in suicidal jumpers primarily affect the thoracic and lumbar regions of the body. In this study, the lumbar region was more likely to be affected in the suicidal group than in the non-suicidal group, which could be explained by the mechanism of falling and landing first on the feet "first-feet landing" [11, 15]. In a case series of 101 patients, Richter found that the lumbar region is more likely to be affected by suicidal jumpers [11]. As seen in previous studies and the second prospective study of the Spine Study Group of the German Association on Trauma Surgery, we also found that L1 and T12 fractures represent the majority of traumatic spine fractures, with a decrease in their incidence at the beginning of the thoracic spine and the end of the lumbar spines [5, 11, 16].

Co-injuries usually accompany traumatic fractures of the spine, and in the case of suicidal jumping, the extremities are mostly affected [3, 5, 11, 15]. These accompanying injuries contributed to the worsening of the clinical and medical conditions of the patients at presentation. In our study, the initial haemoglobin level was lower in the suicidal jumpers than in the non-suicidal group, which could be attributed to co-injuries with subsequent blood loss. Moreover, suicidal patients tend to jump during the early morning hours, when the presence of other people to witness the injury is less likely, which could delay the emergency transport of patients to the hospital; thus, the initial haemoglobin level would decrease during this time.

We believe that treating severe spine fractures should be performed primarily through surgery to achieve three goals: decompression of the neural tissues, stabilisation of the spine, and reduction of the deformity. All the patients in our cohort underwent a dorsal approach with pedicle screw placement. Boucher first described this technique in 1959 [17]. Since then, this treatment has undergone further developments regarding the technique of placement and the material of the screws [16, 18]. Many authors have urged 360° stabilisation (combined approach) of these fractures [16, 19]. In our study, the combined approach was conducted more, especially in suicidal jumpers, than the dorsal approach alone. However, the minimally invasive percutaneous technique was less effective than conventional open surgery, perhaps due to the need for good exposure of the neural structure to perform sufficient decompression.

The radiological findings at the outcomes showed that despite stabilisation, patients showed some deterioration of the deformity (increased SI and decreased LVH) at the follow-up, which could be explained by the increased loading on the spine when patients walk and try to mobilise themselves. Thus, achieving good radiological outcomes with good sagittal alignment and better correction of the loss of vertebral height seems crucial in managing these fractures to achieve good clinical outcomes. As previous studies showed a good correlation between sagittal index (SI) and loss of vertebral height (LVH) with clinical outcomes [12, 13, 20], we also observed this correlation in our study, with a slight deterioration of the radiological outcomes at follow-up, accompanied by a slight increase in pain in the two groups. In our cohort, most patients had no neurological deficits at follow-up, and the pain reduction was significant compared to the baseline. Postoperative complications and mortality rates seemed to be low after surgical treatment for traumatic spine fractures. Surgical approaches and treatment outcomes do not differ significantly between suicidal and non-suicidal [5, 11]. In our cohort, the duration of surgery was significantly longer in the suicide group. This difference could be attributed to many factors, including intraoperative findings with or without dural injury and the timing of the surgery, as most suicidal cases were presented and consequently operated on in the early morning hours during the on-call service.

This study had some limitations. The measurement of outcomes at follow-up was only available for about half of the patients. The mixed-effects model compensates for this shortage [21]. The follow-up period ranged over a long time between 3 months and more than three years, which contributed to the variability in the outcomes between the patients.

Conclusions

In some aspects, patients with spine fractures due to suicidal jumping differed from non-suicidal patients. They were approximately 11 years younger, tended to be female, and had lower initial haemoglobin values at presentation. These fractures seem to occur early in the morning and affect the lumbar region more frequently in suicidal patients. Since the beginning of the lockdown, the COVID pandemic has significantly influenced the rate of severe spine fractures caused by suicide jumping. The optimal treatment for these spinal fractures is mainly surgical and should be targeted through different

approaches to align the spine better and correct the deformity. The cause of the fracture (suicide vs non-suicide) did not seem to affect outcomes significantly.

Declarations

Acknowledgements: AM, as the first author, designed the study, drafted the protocol, contributed to data extraction and writing the manuscript, SH reviewed the protocol and the manuscript, ZO contributed to data extraction, AA contributed to data extraction, DM, as the senior author, contributed to shaping the study and reviewing the manuscript several times, and was responsible for setting the clinical indications and performing the treatment approaches. All authors approved the final version of the manuscript.

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Code availability: not applicable

Ethics approval: ethical approval was waived in this retrospective cohort study

Consent to participate: not applicable

Consent for publication: not applicable

References

1. Kennedy P, Rogers B, Speer S, Frankel H. Spinal cord injuries and attempted suicide: a retrospective review. Spinal Cord. 1999;37(12):847–52.
2. Suicide [Internet]. Who.int. [cited 2021 Nov 25]. Available from: https://www.who.int/news-room/fact-sheets/detail/suicide.
3. Kim DY, Choi HJ, Park JY, Kim KH, Kuh SU, Chin DK, et al. Burst fractures as a result of attempted suicide by jumping. Korean J Neurotrauma. 2014;10(2):70–5.
4. Värnik A, Kõlves K, van der Feltz-Cornelis CM, Marusic A, Oskarsson H, Palmer A, 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(6):545–51. &#8221.
5. Kano H, Matsuo Y, Kubo N, Fujimi S, Nishii T. Spinal injuries in suicidal jumpers. Spine (Phila Pa 1976). 2019;44(1):E13–8.
6. Ohry A, Weingarden H, Kiwerski J, Otom A, el-Masry WS, Kovindha A, et al. Spinal injury rehabilitation complicated by psychosocial problems. Spinal Cord. 1998;36(4):262–5.
7. Li L (2020). Challenges and Priorities in Responding to COVID-19 in Inpatient Psychiatry. Psychiatric services (Washington DC), 71(6), 624–626.
8. Aichberger MC, Heredia Montesinos A, Bromand Z, Yesil R, Temur-Erman S, Rapp MA, et al. Suicide attempt rates and intervention effects in women of Turkish origin in Berlin. Eur Psychiatry. 2015;30(4):480–5.
9. Carlin GL, Baumgartner JS, Moftakhar T, König D, Negrin LL. Impact of COVID-19 lockdown on suicide attempts: A retrospective analysis of the springtime admissions to the trauma resuscitation room at the Medical University of Vienna from 2015–2020: A retrospective analysis of the springtime admissions to the trauma resuscitation room at the Medical University of Vienna from 2015–2020. Wien Klin Wochenschr. 2021;133(17–18):915–22.

10. Katsuura Y, Osborn JM, Cason GW. The epidemiology of thoracolumbar trauma: A meta-analysis. J Orthop. 2016;13(4):383–8.
11. Richter D, Hahn MP, Ostermann PA, Ekkernkamp A, Muhr G. Vertical deceleration injuries: a comparative study of the injury patterns of 101 patients after accidental and intentional high falls. Injury. 1996;27(9):655–9.
12. Farcy JP, Weidenbaum M, Glassman SD. Sagittal index in management of thoracolumbar burst fractures. Spine (Phila Pa 1976). 1990;15(9):958–65.
13. Keene JS. Radiographic evaluation of thoracolumbar fractures. Clin Orthop Relat Res. 1984;189(189):58–64.
14. Hampton M, Clark M, Baxter I, Stevens R, Flatt E, Murray J, et al. The effects of a UK lockdown on orthopaedic trauma admissions and surgical cases: A multicentre comparative study. Bone & Joint Open. 2020;1(5):137–43.
15. Isbister ES, Roberts JA. Autokabalesis: a study of intentional vertical deceleration injuries. Injury. 1992;23(2):119–22.
16. Reinhold M, Knop C, Beisse R, Audigé L, Kandziora F, Pizanis A, et al. Operative treatment of 733 patients with acute thoracolumbar spinal injuries: comprehensive results from the second, prospective, Internet-based multicenter study of the Spine Study Group of the German Association of Trauma Surgery. Eur Spine J. 2010;19(10):1657–76.
17. Boucher HH. A method of spinal fusion. J Bone Joint Surg Br. 1959;41-B(2):248–59.
18. Aly TA. Short segment versus long segment pedicle screws fixation in management of thoracolumbar burst fractures: Meta-analysis. Asian Spine J. 2017;11(1):150–60.
19. Machino M, Yukawa Y, Ito K, Nakashima H, Kato F. Posterior/anterior combined surgery for thoracolumbar burst fractures–posterior instrumentation with pedicle screws and laminar hooks, anterior decompression and strut grafting. Spinal Cord. 2011;49(4):573–9.
20. Yüksel MO, Gürbüz MS, Gök Ş, Karaarslan N, İş M, Berkman MZ. The association between sagittal index, canal compromise, loss of vertebral body height, and severity of spinal cord injury in thoracolumbar burst fractures. J Neurosci Rural Pract. 2016;7(Suppl 1):57–61.
21. Huque MH, Carlin JB, Simpson JA, Lee KJ. A comparison of multiple imputation methods for missing data in longitudinal studies. BMC Med Res Methodol. 2018;18(1):168.

Figures

a.

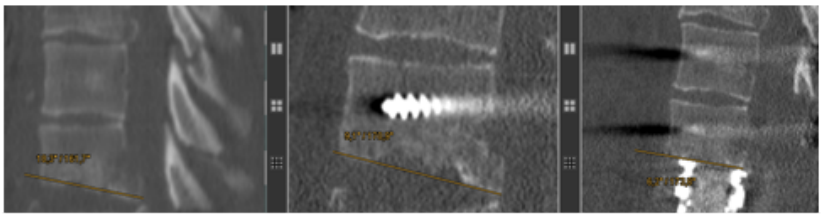

Figure 1

Measurement of sagittal index (SI) and loss of vertebral height (LVH) in a patient, 28 years old, with Th10 fracture after falling from a height (no-suicide). a. The measurement of SI(left image at the presentation= 18.3° + 5°= 23.5°, middle image after dorsal stabilization (long-segment)= 9.1° + 5°= 14.1°, and right image after ventral augmentation= 6.2° + 5°= 11.2°). **b.** The measurement of LVH(left image at the presentation= 12.3/0.5(20.6+26.2)= 0.526, middle image after dorsal stabilization (long-segment)= 15.7/0.5(21.1+26.5)= 0.660, and right image after ventral augmentation=21/0.5(22.5+25.5)= 0.875).

Figure 2

Flow chart of the study

Figure 3

Distribution of the fractures according to the affected vertebrae

Figure 4

Incident rate of spine fractures caused by suicidal jumping vs non-suicidal trauma

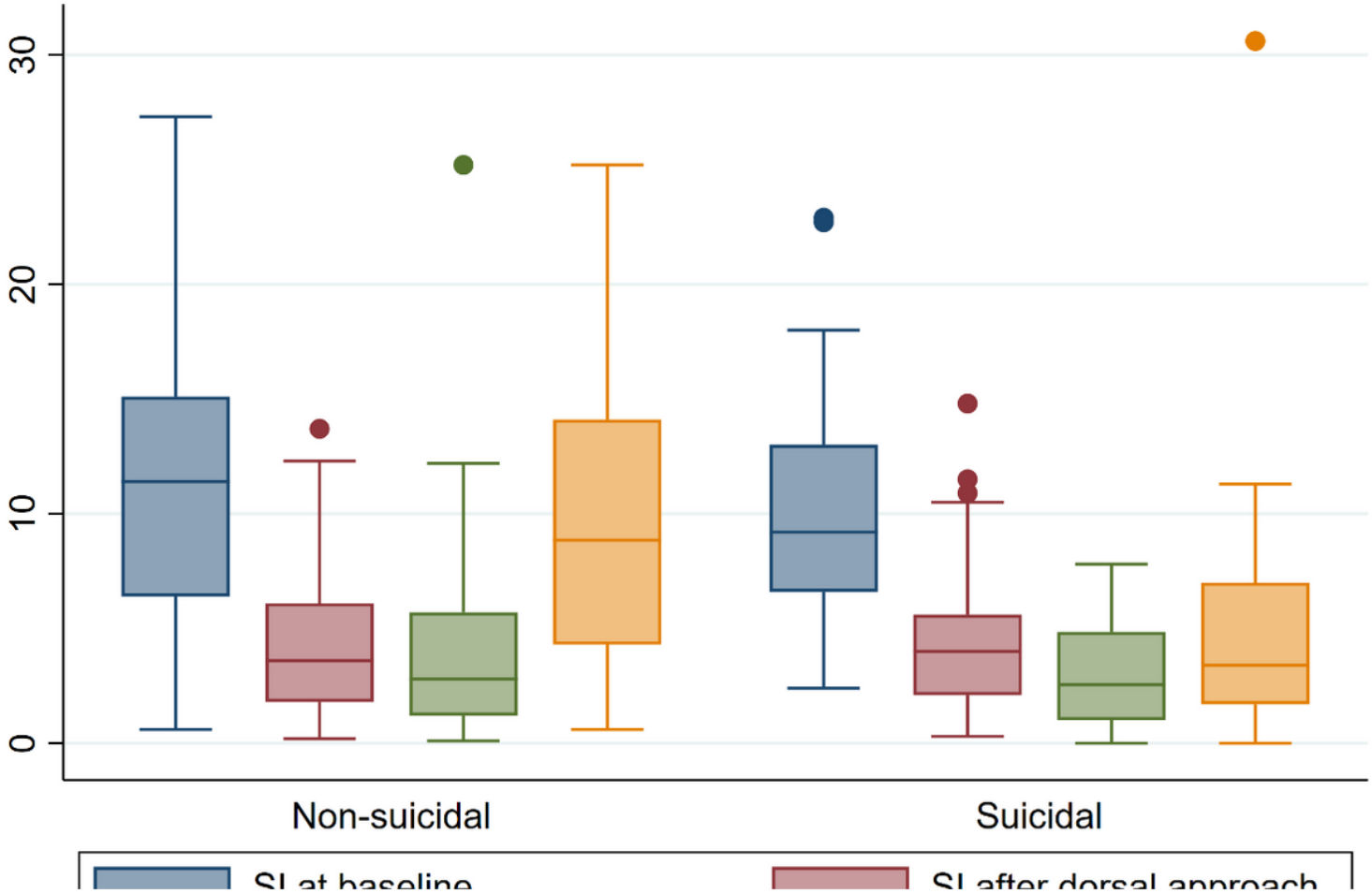

Figure 5

Sagittal index at different time points in the two groups (suicidal vs non-suicidal)

Figure 6

Loss of vertebral height at different time points in the two groups (suicidal vs non-suicidal)

Figure 7

Pain at different time points in the two groups (suicidal vs non-suicidal)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- AppendixI.docx
- STROBEchecklistcohort.docx