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Comparison of pre-drilled v/s undrilled schanz pins in relation to pin tract infection and pin loosening in external fixators

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Abstract
Background: External fixation is a temporizing, and at times definitive, fixation method used in a wide array of orthopedic scenarios. While many factors affect the stability of external fixators, the pin-bone interface has been noted to be the most important in determining both long-term strength and survivability of the construct. This interface depends on the bone quality, pin design, and insertion technique. The aim of this study is to compare pre-drilled v/s un-drilled schanz pins in relation to pin track infection and pin loosening in external fixators
Result: Torque of insertion E1 (near cortex) (10^{-2}, Newton-meter) was significantly higher in undrilled group in comparison to predrilled group (95.0 [66-122] vs. 70.25 [44-95]; p<0.0001). Pin infection was not significantly different at post-operative day 2 (P=0.276), 1st week (P=0.852), 2nd week (P=1.000), 4th week (P=0.383), and 6th week (P=0.588) between predrilled and undrilled pins.
Conclusion: There is no significant difference between predrilled and undrilled schanz pins in uniplanar external fixators when used for compound tibia fracture management in terms of pin loosening or pin tract infection in immediate postop period as well as late periods.

Keywords: Pin tract infection, External fixator, schanz pin, predrilled

Introduction
External fixation is a temporizing, and at times definitive, fixation method used in a wide array of orthopedic scenarios. Consisting of pins, connecting bars and clamps, this construct can be rapidly applied with minimal insult to surrounding soft tissues [1, 2].
While many factors affect the stability of external fixators, the pin-bone interface has been noted to be the most important in determining both long-term strength and survivability of the construct. This interface depends on the bone quality, pin design, and insertion technique. While the quality of the bone is not controlled by the surgeon, the insertion technique and pin selection are modifiable variables that affect the stability and longevity of an external fixation frame [3, 4].

Aim & Objectives
To compare pre-drilled v/s un-drilled schanz pins in relation to pin track infection and pin loosening in external fixators.

Materials and Methods
Patients who presented to Sapthagiri Medical College and Research Center, Bengaluru between September 2019 to December 2020 fulfilling the inclusion criteria were taken into the study. During the study period, we enrolled 30 patients. Each patient was inserted with 6 pins; hence, 120 pins were sufficient. This was a comparative study. All were operated using equal numbers of plain predrilled and undrilled schanz pins in an external fixator system for tibia fractures.
Allocation of pins was randomized. Randomization of test and control pins was done using an online RCT chart.

Inclusion Criteria

- All the patients who presented to Sapthagiri Medical College ER with compound type 2 of Gustilo Anderson and above fracture of tibia during the study period.
- Age group 18 years to 70 years
- Patients who had a minimum follow–up of 6 weeks.

Exclusion Criteria

- Age less than 18 years and more than 70 years.
- Patient with underlying local skin infection where the exfix was planned.
- Patients with extensive internal degloving of soft tissue with skin necrosis evident within a week of ex fix application.
- Patients who ended up in amputation of lower limb within 6 weeks of external fixation.

Surgical Procedure

Thorough wound wash/irrigation was done using normal saline and betadine solution. Incision was made using a 11 number blade about 6 mm vertically at the planned pin insertion site. Skin-bone interface was dissected/opened using a mosquito artery. A pilot drill hole made using a 3.5 mm drill bit with AO drill for every test pin. Pin track irrigated thoroughly to remove the bone dust. A standard numbering of pins were used in order of insertion as follows.

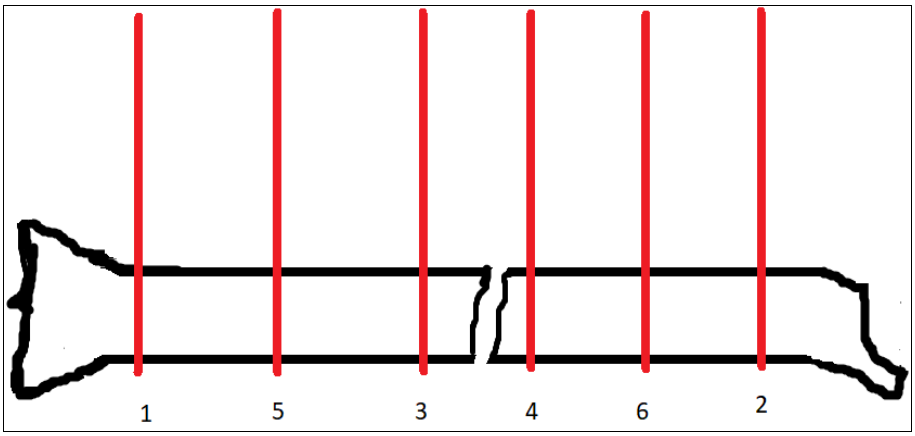

Fig 1: Showing order of pin insertion

A 4.5 mm Schanz pin mounted on a torque measuring screwdriver is introduced into the drilled hole and torque of insertion noted at following 3 stages, entering the near cortex(E1), transit through the medullary canal (T) and entering the far cortex(E2). Similar procedure was followed for the undrilled pin site using schanz pin which served as a test pin. Postoperatively patients were advised to follow uniform pin track care from day 1 of application. Antibiotics were used as per hospital antibiogram (designed by infection control team) protocol. Physiotherapy was initiated as per protocol set by the department of physiotherapy as multiple specialties were involved.

Follow Up

Clinical follow up was done post operatively on day 2 and at 1 week, 2 weeks, 4 weeks and 6 weeks follow ups. In subjects, who required removal of ex fix at the end of 6 weeks, a standard procedure was used where the torque of removal was measured and maximum value noted. Outcomes were measured clinically by symptomatology and signs, radio logically by plain X-rays if needed and microbiologically by swab cultures if needed at each follow up depending on severity of pin tract infection. MON (MAZ OXFORD NUFFIELD) pin infection grading system was used as a standard for quantification of PTI and managed according to the same guidelines.

Observations and Results

A total of 30 patients were enrolled in the study. Four patients were excluded from final analysis due to: below knee amputation (n=2), lost to follow-up (n=1), and CRIF+IMIL (n=1). Results of the study have been presented below:

Mean age of the patients was 34.46 years with a range from 21 years to 59 years with 65.38% of the patients (n=17) being males and 34.62% of the patients (n=9) being females. Diabetes was present in 7.69% patients (n=2).

Road traffic accident (RTA) was the mode of injury in 84.6% patients (n=22) while 15.4% patients (n=4) injured due to fall (fig 3).

Type 2 fracture was present in 30.77% patients (n=8). Type 3a, 3b, and 3c fracture was present in 61.54% (n=16), 3.85% (n=1), and 3.85% (n=1) patients respectively (table 4 and fig 4).

Mean time between injury and surgery was 6.73 hours with a range from 2 hours to 28 hours and mean duration of surgery was 37.50 minutes with a range from 30 min to 45 min. Mean duration of post-operative IV and oral antibiotics was 2.38 days and 7.58 days respectively. Duration of post-operative IV and oral antibiotics ranged from one day to 7 days, and 7 days to 10 days respectively.

Torque of insertion

A total of 6 pins (3 predrilled and 3 undrilled) were inserted in each patient. Hence, a total of 156 pins (78 predrilled and 78 undrilled) pins were inserted.

We observed that torque of insertion E1 (near cortex) (10^{-2}, Newton-meter) was significantly higher in undrilled group in comparison to predrilled group (95.0 [66-122] vs. 70.25 [44-95]; $p<0.0001$). Torque of insertion T (transit in canal) (10^{-2}, Newton-meter) was significantly higher in undrilled group in comparison to predrilled group (32.15 [18-45] vs. 41.50 [29-50]; $p<0.0001$). Torque of insertion E2 (far cortex) (10^{-2}, Newton-meter) was significantly higher in undrilled group in comparison to predrilled group (73.0 [60-86] vs. 96.50 [77.5-116.0]; $p<0.0001$).

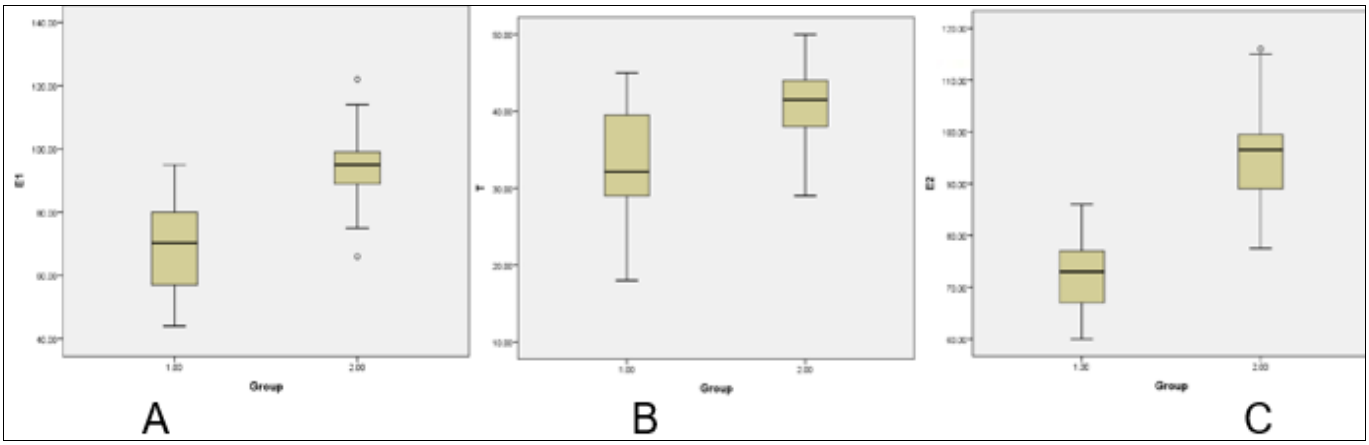

Fig 2: Box-plot showing comparison of torque of insertion; A) E1; B) T, C) E2; X-axis shows groups; 1: Predrilled, 2:Undrilled; Y-axis shows torque of insertion

We categorized torque of insertion into mild, moderate, and severe. We observed that severity of E1 torque of insertion was significantly higher in undrilled pins in comparison to predrilled pins (p<0.001). Torque of insertion (T) was mild in both the groups while severity of E2 torque of insertion was significantly higher in undrilled pins in comparison to predrilled pins (p<0.001).

Table 1: Comparison of torque of insertion between predrilled and undrilled pins

Torque of insertion		Predrilled pins (n=78)	Undrilled pins (n=78)	P Value
E1	Mild	36	1	<0.0001
	Moderate	35	25	
	Severe	7	52	
T	Mild	78	78	-
	Moderate	0	0	
	Severe	0	0	
E2	Mild	29	0	<0.0001
	Moderate	49	25	
	Severe	0	53	

Data shown as frequency

Pin infection

Our study observed that pin infection was not significantly different at post-operative day 2 (P=0.276), 1st week (P=0.852), 2nd week (P=1.000), 4th week (P=0.383), and 6th week (P=0.588) between predrilled and undrilled pins. Table 2 shows that grade of infection was comparable in predrilled and undrilled pins at post-operative day 2 (P=1.000), one week (P=0.601), 2 week (P=0.995), 4 week (P=0.738), and 6 week (P=0.805)

Table 2: Grades of Infection

		Predrilled (n=78)	Undrilled (n=78)	P Value
Post-operative day 2	Healthy	74	73	1.000#
	Grade 1	4	5	
One week	Healthy	23	31	0.601#
	Grade 1	35	29	
	Grade 2	18	16	
	Grade 3	2	2	
Two week	Healthy	27	26	0.995#
	Grade 1	29	30	
	Grade 2	18	17	
	Grade 3	3	4	
	Grade 4	1	1	
Four week	Healthy	11	11	0.738#
	Grade 1	57	52	
	Grade 2	7	11	
	Grade 3	3	4	
Six week	Healthy	10	9	0.805#
	Grade 1	49	46	
	Grade 2	15	18	
	Grade 3	1	3	
	Grade 4	3	2	

Data shown as frequency

Incidence of Infection with torque of insertion

Table 3: Incidence of Infection in torque of insertion (E1)

		Infection	No-infection	P Value
PoD-2	Low (n=37)	0	37 (100%)	0.194
	Moderately High (n=60)	5 (8.3%)	55 (91.7%)	
	High (n=59)	3 (5.1%)	56 (94.9%)	
One Week	Low (n=37)	9 (24.3%)	29 (75.7%)	0.025
	Moderately High (n=60)	21 (35%)	39 (65%)	
	High (n=59)	8 (13.6%)	51 (86.4%)	
Two Week	Low (n=37)	10 (27%)	27 (73%)	0.132
	Moderately High (n=60)	22 (36.7%)	38 (63.3%)	
	High (n=59)	12 (20.3%)	47 (79.7%)	
Four Week	Low (n=37)	6 (16.2%)	31 (83.8%)	1.000
	Moderately High (n=60)	10 (16.7%)	50 (83.3%)	
	High (n=59)	9 (15.3%)	50 (84.7%)	
Six Week	Low (n=37)	9 (24.3%)	28 (75.7%)	0.824
	Moderately High (n=60)	18 (30%)	42 (70%)	
	High (n=59)	15 (25.4%)	44 (74.6%)	

Data shown as frequency and percentages

Table 4: Incidence of Infection in torque of insertion (E2)

		Infection	No-infection	P Value
PoD-2	Low (n=29)	0	29 (100%)	0.150
	Moderately High (n=74)	3 (4.1%)	71 (95.9%)	
	High (n=53)	5 (9.4%)	48 (90.6%)	
One Week	Low (n=29)	10 (34.5%)	19 (65.5%)	0.100
	Moderately High (n=74)	20 (27%)	54 (73%)	
	High (n=53)	8 (15.1%)	45 (84.9%)	
Two Week	Low (n=29)	9 (31%)	20 (69%)	0.318
	Moderately High (n=74)	24 (32.4%)	50 (67.6%)	
	High (n=53)	11 (20.8%)	42 (79.2%)	
Four Week	Low (n=29)	4 (13.8%)	25 (86.2%)	1.000
	Moderately High (n=74)	12 (16.2%)	62 (83.8%)	
	High (n=53)	9 (17%)	44 (83%)	
Six Week	Low (n=29)	9 (31%)	20 (69%)	0.463
	Moderately High (n=74)	22 (29.7%)	52 (70.3%)	
	High (n=53)	11 (20.8%)	42 (79.2%)	

Data shown as frequency and percentages

Discussion

Uniplanar external fixators were used in 30 patients who met the inclusion criteria and were considered for study. One patient was lost to follow up after 2 weeks and hence was excluded from study. 2 patients, a diabetic with type 3a Gustlio Anderson type fracture developed severe wound infection and another with type 3c Gustilo Anderson fracture with failed revascularization attempt due to thrombosis in distal segment of vessel underwent below knee amputation and were excluded from study. In 1 patient, an external fixator was converted to IMIL in the 3rd week for early mobilization as the patient had bilateral compound tibia fracture. At the end a total of 26 patients were included and studied.

Mean duration of post-operative IV and oral antibiotics was 2.38 days and 7.58 days respectively. Duration of post-operative IV and oral antibiotics ranged from one day to 7 days, and 7 days to 10 days respectively based on varying wound characteristics. Local antibiotic injection (gentamycin) was used for grade 3 infections in 28 pins of our study and as for local prophylactic antimicrobials, there is some clinical and laboratory evidence that administering them reduces the incidence of pin site infections, although this method is not a standard of practice currently. Poly trauma cases are most commonly managed in intensive care units hence strict adherence to hospital based antibiograms is necessary to avoid nosocomial infections leading to sepsis. Even though there were deviations from hospital antibiotic policy in selected cases, overall antibiotic therapy remained almost the same for all cases in order to avoid confounding. The optimal regimen and time course are yet to be determined for prophylactic antibiotics**.**

We also compared if pin infection at 1st week, 2nd week, 4th week, and 6th week was different with pin infection at postoperative day 2 in all pins.

We observed that pin infection was significantly higher at 1st week (P=0.010), 2nd week (P=0.018), and 6th week (P=0.039) in comparison to pin infection at postoperative day 2. This implies that duration of external fixator frame is an important variable that contributes to infection probably due to mechanical loosening as stated in previous studies by Gordon *et al.* [5]

We observed that torque of insertion E1 (near cortex) (10^{-2}, Newton-meter) was significantly higher in undrilled group in comparison to predrilled group (95.0 [66-122] vs. 70.25 [44-95]; p<0.0001). Torque of insertion T (transit in canal) (10^{-2}, Newton-meter) was significantly higher in undrilled group in comparison to predrilled group (32.15 [18-45] vs. 41.50 [29-50]; p<0.0001). Torque of insertion E2 (near cortex) (10^{-2}, Newton-meter) was significantly higher in undrilled group in comparison to predrilled group (73.0 [60-86] vs. 96.50 [77.5-116.0]; p<0.0001). As we can make out from the above statistics, overall insertional torque remained high in undrilled

group as compared to predrilled group in our study.

There is evidence from animal studies conducted by Lawes *et al.* [6] that high insertional torque delays pin bone interface loosening and has relatively good stability compared with those pins inserted with low torque. We categorized torque of insertion as high, moderate and low and studied incidence of infection at each follow up and found that there was no statistically significant difference between these groups. We also compared PTI incidence in predrilled and undrilled groups at each follow up as evident from table 2 which indicates that there is no difference between the two groups.

Conclusion

There is no significant difference between predrilled and undrilled schanz pins in uniplanar external fixators when used for compound tibia fracture management. Predrilling is an additional step in the process that contributes to extended duration of surgery, even though not calculated in our study, can be skipped in damage control orthopedic surgeries so as to minimize the adverse effects of anesthesia as there is no difference in infection rates.

Until more evidence is available, the choice of prophylactic antibiotic regimen, method of pin track care should be guided by the clinician's experience for the particular orthopedic procedure and patient`s comorbidities.

We suggest direct insertion of pins in DCO to save time while achieving equivalent results to predrilled pin insertion. Early conversion from external fixator to definitive fracture stabilization modality whenever possible as rate of pin tract infection increases with duration of pin in situ. Local and systemic antibiotics are useful in controlling grade 2 and 3 infections. In external fixator applications other than DCO, the surgeon can use the method which he/she is comfortable with as the difference of infection rates is not statistically significant.

Limitations of the study

As the study is not blinded, it can cause inter observer bias. We have not considered the bony differences with cancellous and cortical bone which can cause variation of the results. The compliance of the patients with proper pin care may have varied due to varying levels of education, which impacts the study adversely.

References

1. Ziran BH, Smith WR, Anglen JO, Tornetta Iii P. External fixation: How to make it work. Instr Course Lect. 2008;57:37-49.
2. Etter C, Burri C, Claes L, Kinzl L, Raible M. Treatment by external fixation of open fractures associated with severe soft tissue damage of the leg. Biomechanical principles and clinical experience. Clin Orthop Relat Res. 1983;178:80-8.
3. Aro HT, Markel MD, Chao EY. Cortical bone reactions at the interface of external fixation half-pins under different loading conditions. J Trauma. 1993;35(5):776-85.
4. Kasman RA, Chao EYS. Fatigue performance of external fixator pins. J Orthop Res. 1984 Jan 1 [cited 2019 Jan 19];2(4):377-84. Available from: http://doi.wiley.com/10.1002/jor.1100020410
5. Gordon JE, Kelly-Hahn J, Carpenter CJ, Schoenecker PL. Pin site care during external fixation in children: results of a nihilistic approach. J Pediatr Orthop. 2000;20(2):163-5.
6. Lawes TJ, Scott JCR, Goodship AE. Increased Insertion Torque Delays Pin-Bone Interface Loosening in External Fixation With Tapered Bone Screws. J Orthop Trauma. 2004;18(9):617-22.