



Effect of chronic heavy smoking on ankle fracture healing

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Cigarette smoking and bone

- Osteomyelitis and delayed union/non-union in long bone fractures¹.
- Outcome of ankle fracture remains unknown.



- Castillo RC, Bosse MJ, MacKenzie EJ, Patterson BM; LEAP Study Group. Impact of smoking on fracture healing and risk of complications in limb-threatening open tibia fractures. *J Orthop Trauma*. 2005 Mar;19(3):151-7.

Retrospective comparative study

- In this study we analysed the effect of chronic heavy smoking on closed ankle fracture healing and outcomes.



Study design- prospective intent

- Identical treatment protocol
- 173 consecutive chronic heavy smokers
- Closed ankle fractures
- An age and sex matched control group and Lauge-Hansen classification system
- Patient demographics, co-morbidities, mechanism of injury, and clinical details
- Universal advise



Study sub-groups and outcome factors

- **CHS with no surgical intervention (CHS-Conservative)**
- **CHS who ultimately underwent ORIF (CHS-Surgical)**
- CG with no surgical intervention (C-Conservative)
- CG who underwent ORIF (C-Surgical)

- Primary outcome factors
 - *Time to fracture union*
 - *Wound healing*

- Secondary outcome factors
 - Postoperative complications
 - Incidence of delayed union
 - Non-union
 - Re-intervention

- Minimum period of follow-up was 24 months



	CHS group	Control
	n = 173	n = 173
Gender		
Male	121	118
Female	52	55
Age (at time of injury)		
Mean	43	47
Minimum-Maximum	27-66	29-62
Standard deviation	±9.6	±6.4



Mobility	CHS	Control
Independent	172	173
Dependent	1	0
ADLs		
Independent	172	173
Dependent	1	0

	CHS group	Control
	n = 173	n = 173
Cause of injury		
Mechanical fall	144	162
Sports injuries	9	2
Road traffic accidents	8	5
Assaults	8	3
Others	4	1
Mechanism of injury		
Eversion	8	1
Inversion	31	47
Dorsiflexion	59	45
Plantar flexion	75	80
Type of injury- closed		
Uni-malleolar	42	52
Bi-malleolar	79	68
Tri-malleolar	33	25
Fracture dislocation	19	28

Lauge Hansen classification	CHS	Control
Supination-adduction	22	23
Supination-external rotation	103	99
Pronation-external rotation	19	23
Pronation-abduction	29	28
Time to surgery (days)	0-8	0-9
Intervention		
Conservative	88	88
External fixator	32	37
Surgical fixation	85	85

	CHS group	Control
Time to wound healing		
Mean (weeks)	6	2
Minimum-Maximum	4-9	1-3
Standard deviation	±2	±1
Time to union		
Mean (weeks)	13	8
Minimum-Maximum	10-16	6-9
Standard deviation	±3	±1
Follow-up		
Mean (months)	29.8	26.5
Minimum-Maximum	24-33	20-36
Standard deviation	±3.2	±4.1

	CHS group	CHS group	Control	Control	CHS vs. C
	n=173 (%)	T-test	n=173 (%)	T-test	Pearson
Complications					
Post injury/surgery pain (4w)	38 (22.0)	<.001**	4 (2.3)	.045*	<.001**
Bleeding (oozing) (4w)	0 (0.0)	-	0 (0.0)	-	-
Swelling (4w)	18 (10.4)	<.001**	2 (1.2)	.158	<.001**
Infection- superficial	13 (7.5)	<.001**	2 (1.2)	.158	<.001**
Infection - deep	12 (6.9)	<.001**	1 (0.6)	.319	<.001**
Mal union	0 (0.)	-	1 (0.6)	-	-
Delayed union	24 (13.9)	<.001**	4 (2.3)	.045*	<.001**
Non union	6 (3.5)	.014	1 (0.6)	.319	<.001**
Neuro impairment	0 (0.0)	-	0 (0.0)	-	-
Comp. syndrome	0 (0.0)	-	0 (0.0)	-	-
LRTI	15 (8.7)	<.001**	2 (1.2)	.158	<.001**
UTI	4 (2.3)	.045*	1 (0.6)	.319	<.001**
DVT	2 (1.2)	-	0 (0.0)	-	-
Satisfactory RoM (4w)	152 (87.9)	<.001**	169 (97.7)	<.001**	<.001**
Mobility at last R/V					
Same to before injury	165 (95.4)	<.001**	171 (98.8)	<.001**	<.001**
Dependent – worse	8 (4.6)	.004*	2 (1.2)	.158	<.001**

	CHS-Con	CHS-Sur	C-Con	C-Sur
Time to wound healing	5	7	2	2
Mean (weeks)	4-6	4-9	1-3	1-3
Minimum-Maximum	±1	±2	±1	±1
Standard deviation				
Time to union	11	13	7	8
Mean (weeks)	10-13	10-16	6-8	7-9
Minimum-Maximum	±1	±3	±1	±1
Standard deviation				
Follow-up				
Mean (months)	27.2	30.1	24.6	30.5
Minimum-Maximum	24-33	26-34	20-29	37-36
Standard deviation	±2.1	±3.3	±3.5	±2.4

	CHS-Con vs. C-Con	CHS-Sur vs. C-Sur	CHS-Con vs. CHS-Sur
Postoperative complications	Paired T-test	Paired T-test	Paired T-test
Postoperative pain (4w)	.004*	<.001**	<.001**
Bleeding (oozing) (4w)	-	-	-
Swelling (4w)	-	<.001**	<.001**
Infection- superficial	.158	.002*	.007*
Infection - deep	.158	-	.013*
Mal union	-	-	-
Delayed union	.007*	<.001**	.004*
Non union	.083	-	.159
Mild neuro impairment	-	-	-
Comp. syndrome	-	-	-
LRTI	.013*	.007*	.320
UTI	.158	-	.159
DVT	-	-	-
Satisfactory RoM	.045*	<.001**	<.001**
Mobility at last R/V			
Same to before injury	.320	.024*	.013*
Dependent - worse	.320	.024*	.045*

Summary

- CHS surgical cohort revealed a statistically significant delay in fracture union, when compared to conservatively managed CHS and controls.
- Further analysis of the CHS surgical cohort revealed a significant correlation between smoking and postoperative duration of pain, prolonged fracture site swelling, superficial and deep wound infection, delayed union and delayed wound healing, when compared to controls.
- Further analysis of the conservatively managed CHS revealed a slight increase in the incidence of post injury duration of pain, prolonged fracture site swelling and delayed union, when compared to controls.

Outcome

- Chronic heavy smokers with ankle fractures requiring surgical intervention should be informed of their increased risk of **delayed fracture** and **delayed wound healing**.
- Orthopaedic surgeons need to encourage their patients to enter into smoking cessation programs.

Thank you

- Questions