

## Outcomes in acute vs. delayed definitive fixation of bicondylar tibial plateau fractures

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**INTRODUCTION:** This study aims to determine the efficacy of primary definitive fixation for bicondylar tibial plateau fracture, comparing surgical outcomes of patients stratified by either single definitive fixation within or >72 hours, to a staged approach with external fixation.

**METHODS:** Retrospective chart review was performed at three American College of Surgeons (ACS) Level 1 Trauma Centers for patients treated for bicondylar tibial plateau fractures identified by OTA classification 41C and corresponding CPT codes. All patients were initially temporized until initial surgery with a knee immobilizer. Patients were divided into 3 groups, (1) staged fixation with temporizing external fixator (ex-fix) followed by open reduction internal fixation (ORIF), (2) acute primary ORIF within 72 hours, (3) subacute primary ORIF > 72 hours. Data collected included fracture classification, hospital length of stay (LOS), time from injury to initial and/or definitive surgery, method of surgical fixation, wound closure, perioperative complications, and unplanned return to the operating room (uRTOR) within 12 months of definitive fixation.

**RESULTS:** 192 patients met inclusion criteria: 100 patients treated with staged fixation with temporizing ex-fix (group 1), 79 patients were treated with definitive ORIF ≤72 hours (group 2), 13 patients were treated with definitive ORIF >72 hours (group 3). Patient characteristics including smoking status, end stage renal disease (ESRD), obesity, mechanism of injury were significantly different between groups (Table 1). Incidence of open fracture was not significant between groups (Table 2). Time to initial surgery was lowest in group 1 and highest in group 3 ( $p < 0.001$ ). Length of stay from definitive surgery was significant between groups, with group 2 being the lowest ( $4.78 \pm 6.08$  days) and highest in group 3 ( $9.77 \pm 23.2$  days) ( $p < 0.001$ , Table 2). Incidence of any complication was not significant between groups. Of our included patients, 144 had radiographic analysis related to AO-OTA classification; patients in group 1 were more commonly 41C3, and evenly spread between 41C1-3 in group 2 ( $p = 0.029$ , Table 4). Wound dehiscence, wound drainage, and compartment syndrome complications after initial surgery were significantly higher in those patients treated first with external fixation than those treated with primary fixation <72 hours (Table 3). Incidence of no complication was highest in group 2 (81%) vs. group 1 (37.1%) or group 3 (69.2%) ( $p < 0.001$ ). In group 1, factors predictive of any complication included asthma ( $p = 0.073$ ); in group 2, predictive factors were cancer ( $p = 0.038$ ) and ESRD ( $p = 0.038$ ); in group 3 there were no predictive factors of any complication. Factors predictive of uRTOR in group 1 were cardiovascular disease (CVD) ( $p = 0.006$ ), there were no predictive factors for uRTOR in group 2 or group 3.

**DISCUSSION AND CONCLUSION:** Recent literature has challenged the traditional requirement of staged fixation of bicondylar tibial plateau fractures due to concern for wound complications; however, no objective measure exists to determine appropriate timing based on patient characteristics. This study demonstrates that carefully selected patients may be treated with early definitive ORIF within 72 hours of injury while minimizing complications and unplanned return to the operating room. Predictive analysis in this cohort is limited by the sample size included for those patients treated by primary definitive fixation. Future studies will aim to better elucidate patient characteristics that allow for patients to be accurately stratified into appropriate treatment groups.

Variable	Group 1				Group 2				Group 3			
	Mean		S.D.		Mean		S.D.		Mean		S.D.	
	Value	p-value	Value	p-value	Value	p-value	Value	p-value	Value	p-value	Value	p-value
Age	45.2	0.12	48.1	0.12	45.2	0.12	48.1	0.12	45.2	0.12	48.1	0.12
Gender	65	0.85	35	0.85	58	0.85	21	0.85	65	0.85	35	0.85
Smoking Status	42	0.001	58	0.001	38	0.001	41	0.001	42	0.001	58	0.001
ESRD	15	0.038	85	0.038	12	0.038	67	0.038	15	0.038	85	0.038
Obesity	35	0.001	65	0.001	28	0.001	51	0.001	35	0.001	65	0.001
Mechanism of Injury	55	0.001	45	0.001	48	0.001	31	0.001	55	0.001	45	0.001
Open Fracture	12	0.001	88	0.001	8	0.001	71	0.001	12	0.001	88	0.001
Time to Surgery	12.5	<0.001	4.8	<0.001	28.3	<0.001	9.8	<0.001	12.5	<0.001	4.8	<0.001
LOS	10.2	<0.001	4.8	<0.001	9.8	<0.001	10.2	<0.001	10.2	<0.001	4.8	<0.001
Complications	63	0.001	37	0.001	28	0.001	51	0.001	63	0.001	37	0.001
uRTOR	15	0.006	85	0.006	12	0.006	67	0.006	15	0.006	85	0.006
ESRD	15	0.038	85	0.038	12	0.038	67	0.038	15	0.038	85	0.038
Obesity	35	0.001	65	0.001	28	0.001	51	0.001	35	0.001	65	0.001
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Time to												

Table 1	Group 1				Group 2				Group 3				p-value
	Mean	Standard Deviation	Count	%	Mean	Standard Deviation	Count	%	Mean	Standard Deviation	Count	%	
Open fracture	10		10	100%	66		66	84.7%	10		10	100%	0.001
Yes			10	100%			7	9.50%			0	0%	
Time interval surgery	0.88	0.88			1.0	0.88			0.83	0.82			0.001
Length of stay (in hospital)	7.36	6.9			5.8	6.71			10.83	23.4			

Table 3: AO-OTA Classification by Group									
AO-OTA Classification	Patients (n)	Group 1		Group 2		Group 3		p-value	
		Mean (range)	S.D.	Mean (range)	S.D.	Mean (range)	S.D.		
Median incision	Patients (n)	40 (20-50)	4.7 (2.0)	40 (20-50)	4.7 (2.0)	40 (20-50)	4.7 (2.0)	0.999	
Incision extension	Patients (n)	1 (2.00)	0.00	2 (3.00)	0.00	0 (0.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
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Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (20.00)	0.00	10 (20.00)	0.00	10 (20.00)	0.00	0.005	
Incision extension	Patients (n)	10 (							

Table 4: (n = 146)								
		Group 1		Group 2		Group 3		p-value
		Count	N %	Count	N %	Count	N %	
AO-OTA Classification	41C1	10	19.10%	27	34.20%	6	46.20%	0.029
	41C2	12	23.10%	26	33.00%	1	7.70%	
	41C3	36	67.80%	30	37.80%	6	46.10%	