

TABLE E-1 Studies Reporting Outcomes Following Acute Treatment* of Multiple-Ligament Knee Injuries

Study, Year	Average Duration of Follow-up (mo)	N	Injury Classification†	Rehabilitation Classification	Surgical Approach, Repairs/Reconstructions, and Grafts‡
Frassica et al. ¹² , 1991	57	12	2 KDII, 10 KDIIM	Immobilization	Open arthrotomy. Suture repair: 6 ACL ligament avulsions, 10 PCL ligament avulsions. Reconstruction: 2 PCL tears.
Harner et al. ¹³ , 2004§	44	19	7 KDIIL, 10 KDIIM, 2 KDIV	Immobilization	Arthroscopic approach and open arthrotomy. Suture repair: ACL and PCL ligament avulsions, MCL tears. Allograft reconstruction: midsubstance ACL, PCL, and LCL tears.
Ibrahim ¹⁴ , 1999	39	41	10 KDII, 13 KDIIL, 18 KDIIM	Early mobility	Arthroscopic approach. Bone-patellar tendon-bone autograft reconstruction: midsubstance ACL tears. Hamstring autograft reconstruction: midsubstance PCL tears. Suture repair: MCL and LCL tears.
Ibrahim et al. ¹⁵ , 2008	43	20	5 KDIIL, 15 KDIIM	Early mobility	Arthroscopic approach. Hamstring autograft reconstruction: midsubstance ACL and PCL tears. Suture repair and/or allograft reconstruction: MCL and LCL tears.
Mariani et al. ¹⁶ , 1999	83	23	3 KDIIL, 6 KDIIM, 14 KDIV	Immobilization/ Early mobility	Open arthrotomy. Suture repair: LCL, ACL, and PCL tears. Hamstring autograft reconstruction: ACL tears. Bone-patellar tendon-bone autograft reconstruction: PCL tears.
Martinek et al. ¹⁷ , 2000#	65	22	3 KDIIL, 19 KDIIM	Early mobility	Open arthrotomy. Suture repair: 13 ACL/PCL tears. 8 ACL autograft reconstructions with PCL tear suture repair. 1 ACL suture repair with PCL autograft reconstruction.
Noyes and Barber-Westin ¹⁸ , 1997	58	7	1 KDIIL, 5 KDIIM, 1 KDIV	Early mobility	Arthroscopic approach. Allograft reconstruction: ACL, PCL, LCL midsubstance tears. Suture repair: 1 ACL

					and 1 PCL midsubstance tear.
Rios et al. ²⁰ , 2003	36	21	4 KDI, 1 KDII, 3 KDIIL, 9 KDIIM, 4 KDIV	Immobilization	Open arthrotomy. Suture repair: LCL, PLC, and/or MCL with ACL or PCL (not both cruciates). Suture repair: 13 PCL ligament avulsions. Suture repair: 16 ACL ligament avulsions. Dacron and bone-patellar tendon-bone augmentation: midsubstance ACL and PCL tears.
Shapiro and Freedman ²¹ , 1995	51	7	2 KDIIL, 4 KDIIM, 1 KDIV	Early mobility	Open arthrotomy. Achilles tendon or bone-patellar tendon-bone allograft reconstruction: 5 ACL and PCL tears. 1 ACL augmentation with Achilles tendon and PCL bone-patellar tendon-bone allograft reconstruction. 1 ACL bone-patellar tendon-bone autograft with PCL allograft reconstruction. Suture repair: LCL and MCL tears.
Shelbourne et al. ²² , 2007	55	11	11 KDIIL	Early mobility	Open arthrotomy. ACL bone-patellar tendon-bone autograft reconstructions. En masse suture repair of the LCL and PLC. No repair or reconstruction of PCL.
Talbot et al. ²³ , 2004	27	21	1 KDII, 10 KDIIL, 9 KDIIM, 1 KDIV	Early mobility	Open arthrotomy. Ligament advanced reinforcement system: PCL anterolateral bundle and LCL tears. Suture repair: ACL, PLC, and MCL ligament avulsions.
Thomsen et al. ⁶⁸ , 1984	72	6	2 KDIIL, 2 KDIIM, 2 KDIV	Immobilization	Open arthrotomy. Suture repair: 5 of all affected ligaments, 1 of LCL only.
Wascher et al. ²⁴ , 1999	38	9	3 KDIIL, 6 KDIIM	Early mobility	Diagnostic arthroscopy followed by open arthrotomy. Achilles tendon and bone-patellar tendon-bone allograft reconstruction: ACL and PCL tears. Suture repair: LCL and MCL ligament avulsions.
Yeh et al. ²⁶ , 1999	27	25	9 KDIIL, 12 KDIIM, 4 KDIV	Early mobility	Arthroscopic approach. Bone-patellar tendon-bone reconstruction: 22 PCL tears with autografts and 1 PCL tear with

					allograft. ACL débridement. Suture repair: MCL and LCL tears.
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*Less than three weeks after injury. †The values are given as the number of injuries with each classification. ‡ACL = anterior cruciate ligament, PCL = posterior cruciate ligament, MCL = medial collateral ligament, LCL = lateral collateral ligament, and PLC = posterolateral corner. §Chronic data excluded because of a lack of patients with necessary injury-severity classification. #Six of twenty-two patients required revision because of instability.

TABLE E-2 Studies Reporting Outcomes Following Chronic Treatment* of Multiple-Ligament Knee Injuries

Study, Year	Average Duration of Follow-up (mo)	N	Injury Classification†	Rehabilitation Classification	Surgical Approach, Repairs/Reconstructions, and Grafts‡
Fanelli et al. ²⁷ , 1996§	24 to 60	20	1 KDII, 10 KDIIL, 7 KDIIM, 2 KDIV	Immobilization	Arthroscopically assisted ACL and PCL combined reconstructions. PCL allograft reconstruction: 14 Achilles tendon and 6 bone-patellar tendon-bone. ACL reconstruction: 16 bone-patellar tendon-bone autografts, 3 bone-patellar tendon-bone allografts, 1 Achilles tendon allograft. PLC repair: biceps femoris tenodesis.
Fanelli and Edson ²⁸ , 2002§	24 to 120	35	19 KDIIL, 9 KDIIM, 6 KDIV, 1 KDII	Immobilization	Arthroscopically assisted ACL and PCL combined reconstructions. PCL allograft reconstruction: 26 Achilles tendon, 7 bone-patellar tendon-bone, 2 hamstring. ACL reconstruction: 16 bone-patellar tendon-bone autografts, 12 bone-patellar tendon-bone allografts, 6 Achilles tendon allografts, 1 hamstring autograft. PLC reconstruction: 1 split biceps femoris tendon transfer. Posteromedial corner repair: shift procedure. Grade III MCL tears: suture repair, Achilles tendon, or hamstring autograft reconstruction.
Liow et al. ³⁹ , 2003#	32	14	3 KDI, 2 KDII, 5 KDIIL, 4 KDIIM	Immobilization	Arthroscopic approach. ACL and PCL combined reconstructions. ACL reconstruction: 6 bone-patellar tendon-bone autografts, 2 bone-patellar tendon-bone allografts, 2 hamstring autografts. PCL reconstruction: 10 Achilles tendon allografts, 1 bone-patellar tendon-bone allografts. MCL tears: suture repair with one hamstring autograft. LCL. LCL tears:

					4 hamstring autografts, 2 Achilles tendon allograft augmentations, 1 biceps femoris tendon advancement.
Martinek et al. ¹⁷ , 2000**	65	6	2 KDIIL, 3 KDIIM, 1 KDIV	Early mobility	Open approach. Suture repair: 3 ACL/PCL ligament avulsions. 3 ACL autograft reconstructions with PCL suture repairs.
Noyes and Barber-Westin ¹⁸ , 1997	58	4	4 KDIIL	Early mobility	Arthroscopic approach. Allograft reconstruction: 21 ACL and PCL bone-patellar tendon-bone autografts, 1 LCL. Autograft reconstruction: 1 PCL bone-patellar tendon-bone. 2 posterolateral corner advancements. 1 split biceps femoris tendon augmentation and advancement.
Shelbourne et al. ²² , 2007	55	6	6 KDIIL	Early mobility	Open arthrotomy. ACL bone-patellar tendon-bone autograft reconstructions. En masse suture repair of the LCL and PLC. No repair or reconstruction of PCL.
Strobel et al. ⁶⁹ , 2006	24 to 66	17	17 KDIIL	Immobilization	Arthroscopically assisted ACL and PCL combined hamstring autograft reconstructions. Hamstring autograft reconstruction of the PLC.
Wascher et al. ²⁴ , 1999	38	4	3 KDIIL, 1 KDIIM	Early mobility	Diagnostic arthroscopy followed by open arthrotomy. Achilles tendon and bone-patellar tendon-bone allograft reconstruction: ACL and PCL tears. Suture repair: LCL and MCL ligament avulsions.

*More than three weeks after the injury. †The values are given as the number of injuries with each classification. ‡ACL = anterior cruciate ligament, PCL = posterior cruciate ligament, MCL = medial collateral ligament, LCL = lateral collateral ligament, and PLC = posterolateral corner. §The author analyzed acute and chronic treatment using definitions different from ours. Therefore, all study data were categorized as chronic for comparison because patients were immobilized approximately two to six weeks prior to surgery. #Acute data excluded because of injury severity classification. **Five of six patients required revision because of instability.

TABLE E-3 Studies Evaluating Staged Intervention

Study, Year*	Average Duration of Follow-up (mo)	N	Injury Classification†	Surgical Approach, Repairs/Reconstructions, and Grafts‡
Bin and Nam ³⁰ , 2007	89	15	7 KDIIM, 5 KDIIL, 3 KDIV	Stage 1: 7 MCL suture repairs, 5 LCL suture repairs, and 1 LCL reconstruction. 3 combined LCL and MCL repairs. Stage 2: Arthroscopic approach. 3 ACL reconstructions and 7 PCL reconstructions (both autograft and allograft).
Ohkoshi et al. ³¹ , 2002	40	9	3 KDIIL, 6 KDIIM	Stage 1: Arthroscopically assisted PCL reconstruction: 8 hamstring autograft/synthetic graft hybrid reconstructions. Stage 2: Arthroscopic assisted ACL reconstruction: 6 bone-patellar tendon-bone autograft/synthetic graft hybrid, 1 hamstring autograft/synthetic graft hybrid, 2 bone-patellar tendon-bone autograft reconstructions.
Sun et al. ³² , 2006	23	9	4 KDIIL, 5 KDIIM	Stage 1: Diagnostic arthroscopy. Suture repair: MCL and posteromedial corner. Stage 2: Arthroscopic approach. Combined ACL and PCL reconstruction. ACL reconstruction: 6 hamstring autografts, 2 bone-patellar tendon-bone autografts, 1 bone-quadriceps tendon autograft. PCL reconstruction: hamstring autografts. PLC reconstruction: 4 split biceps femoris tenodesis.
Walker et al. ³³ , 1994§	37	13	6 KDIIL, 5 KDIIL, 2 KDIV	Stage 1: Suture repair: 6 PCL ligament avulsions, 2 ACL ligament avulsions, and both MCL and LCL tears. Bone-patellar tendon-bone autograft reconstruction: 3 PCL tears. Stage 2: Bone-patellar tendon-bone autograft reconstruction: 5 ACL tears, 2 PCL tears.

*All excluded from rehabilitation comparison because of inability to control for surgical timing and variability in rehabilitation protocols. †The values are given as the number of injuries with each classification. ‡ACL = anterior cruciate ligament, PCL = posterior cruciate ligament, MCL = medial collateral ligament, LCL = lateral collateral ligament, and PLC = posterolateral corner. §Considered staged because of intention to treat with follow-up reconstruction for anterior laxity as indicated.