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Outcomes of Isolated HTO and simultaneous HTO and ACL reconstruction: A Systematic Review & Meta-Analysis

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V Dewan: Nothing to disclose

L Rohman: Nothing to disclose

M.Snow:

Aims

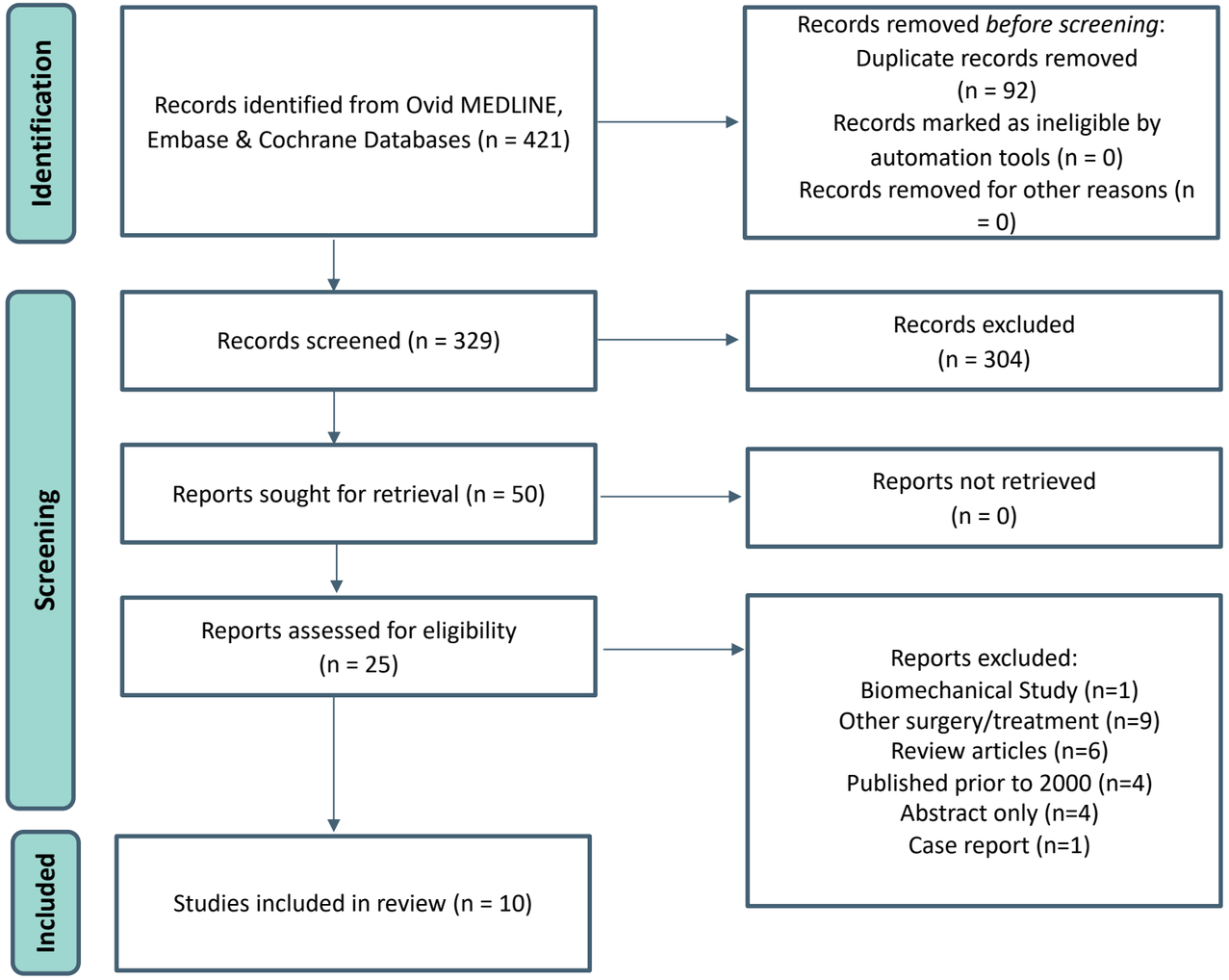
- Review the current evidence on the management ACL deficient knees with medial compartment degeneration treated with isolated HTO or simultaneous HTO and ACL reconstruction

- To assess the following outcomes:
  - Functional outcome scores
  - Progression of OA
  - Revision and failure rate
  - Complications

Methods

- Study was conducted in accordance with the 2020 PRISMA[1]
- Ovid MEDLINE, Embase and Cochrane databases in addition to reference checking
- Inclusion criteria:
  - Any study assessing HTO and ACLR combined or HTO alone for ACLD knees in the setting of MCOA
- Exclusion criteria:
  - Published before 2000, not published in the English language, revision ACLR, cadaveric studies, biomechanical studies

Results


Identification
Records identified from Ovid MEDLINE, Embase & Cochrane Databases (n = 421)
Records removed *before screening*:
Duplicate records removed (n = 92)
Records marked as ineligible by automation tools (n = 0)
Records removed for other reasons (n = 0)
Screening
Records screened (n = 329)
Records excluded (n = 304)
Reports sought for retrieval (n = 50)
Reports not retrieved (n = 0)
Reports assessed for eligibility (n = 25)
Reports excluded:
Biomechanical Study (n=1)
Other surgery/treatment (n=9)
Review articles (n=6)
Published prior to 2000 (n=4)
Abstract only (n=4)
Case report (n=1)
Included
Studies included in review (n = 10)

Study Characteristics & Surgical Technique

	HTO + ACL	Isolated HTO
Total number of patients	145	128
Number of studies included	8	3
Level III evidence	2	2
Level IV evidence	6	1
Mean age	38.8yrs	39.5yrs
Mean follow-up	51.2 months	120.3 months
SURGICAL TECHNIQUE		
Closing wedge osteotomy	32 (22%)	116 (90.6%)
Open wedge osteotomy	113 (78%)	12 (9.4%)
Hamstring ACLR	88.3%	NA
BTB ACLR	11.7%	NA

Functional Outcome Scores

GROUP	Number	Pre-Operative	Post-Operative	Statistical Significance (p-value)
Lysholm Score				
ACL + HTO	111/145	52.3 (95% CI: 47.52-57.15)	82.7 (95% CI: 73.03-92.36)	P<0.05
HTO	26/128	46.8	76.3	P<0.001
IKDC Knee Score				
ACL + HTO	42/145	47.6	72.4	P<0.05
HTO	26/128	NR	64.8	
Tegner Score				
ACL + HTO	28/145	2.9	4.7	P<0.001
HTO	26/128	3.8	4.9	P<0.02

Progression of Osteoarthritis

- 3 studies in combined surgical group and 1 study in HTO group reported pre- and post-operative OA grading
- Quality of data prohibited analysis
- All studies demonstrated progression of OA in both treatment groups
- Williams et al[2]: Reported a statistical significant progression of radiographic OA ($p<0.03$) in HTO group but there was no correlation with Lysholm score ($r^2=0.36$).
- Mehl et al[3]: Progression of Kellgren-Lawrence grade in both treatment groups ($p<0.001$)
  - Greater progression of OA in HTO/ACLR group compared to HTO only group ($p>0.05$)

Cartilage Status

Author	Compartment	Pre-Operative	Post-Operative	Statistical Significance
HTO + ACL Kellgren-Lawrence Grading				
Jin et al[4] (2018)	Medial	Gd1: 10 Gd2: 9 Gd3: 5	Gd1: 8 Gd2: 10 Gd3: 6	0.682
Mehl et al[3] (2017)	Medial	Gd 1.9*	Mean increase of 0.61	NR
HTO + ACL ICRS Arthroscopic Grading				
Akamatsu et al[5] (2010)	Medial	Gd1: 0 (0) Gd2: 3 (3) Gd3: 1 (1)	Gd1: 0 Gd2: 3 Gd3: 1	NR
	Lateral	Gd1: 4 (1) Gd2: 0 (3) Gd3: 0 (0)	Gd1: 1 Gd2: 3 Gd3: 0	NR
Isolated HTO Kellgren-Lawrence				
Mehl et al[3] (2017)	Medial	2.7*	Mean increase of 0.39	NR
Isolated HTO HSS Radiography Score				
Williams et al[2] (2003)	Medial	20.5	19.3	<0.03

*Mean grade of OA

Knee Joint Laxity

HTO & ACL Combined Group

- 8 studies reported knee joint laxity
- All studies reported an improvement in knee joint laxity
- Only one study (Jin et al[4]) reported statistical significance of their results($p<0.001$)

HTO Only Group

- 2 studies reported knee joint laxity
- Williams et al[2] reported that HTO alone had no impact on the persistence of a positive Lachman or pivot-shift test
- Mehl et al[3] performed KT 2000 arthrometer testing: no major difference (statistical significance testing not reported)

Complications & Failure

Complication	HTO + ACL (n=119)	Isolated HTO (n=38)
Infection	1	1
Notchplasty (for painful catching)	3	0
Stiffness	1	0
Pain requiring arthroscopic surgery	2	1
Patellar tendinitis	1	0
Prominent hardware	14	1
Revision Osteotomy	2	0
TKR	0	1
Complication rate	**20.2% (9.5%)**	**10.5% (8.1%)**

Conclusion

- The evidence available was poor in both treatment strategies limiting conclusions.
- Both treatments result in a significant improvement in outcome scores post-surgery
  - Trend towards improved outcomes in combined
- OA progression occurs in both groups
- Complication rates between procedures are comparable

References

1. Page MJ, McKenzie JE, Bossuyt PM, et al. Updating guidance for reporting systematic reviews: development of the PRISMA 2020 statement. J Clin Epidemiol 2021;S0895-4356
2. Williams RJ 3rd, Kelly BT, Wickiewicz TL, Altchek DW, Warren RF (2003) The short-term outcome of surgical treatment for painful varus arthritis in association with chronic ACL deficiency. J Knee Surg 16(1):9–16
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4. Jin C, Son EK, Jin QH et al. Outcomes of simultaneous high tibial osteotomy and anterior cruciate ligament reconstruction in anterior cruciate deficient knee with osteoarthritis. BMC Musculoskeletal Disorders. 2018;19:228
5. Akamatsu Y, Mitsugi N, Taki N, Takeuchi R, Saito T (2010) Simultaneous anterior cruciate ligament reconstruction and opening wedge high tibial osteotomy: report of four cases. Knee 17(2):114–118