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Motor Success and Reoperation After Surgery for Adult Intermittent Exotropia: A Systematic Review and Meta-analysis

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Abstract: *Objective:* To estimate pooled motor success and reoperation rates in adult intermittent exotropia (IXT), evaluating the impact of surgical technique, follow-up, and success definitions. *Methods:* We searched PubMed, Embase, and Scopus (inception–March 2026) for adult (≥ 18 years) intermittent exotropia surgery outcomes. Proportions were Freeman-Tukey transformed and pooled via a random-effects model. We assessed MINORS quality and performed subgroup/sensitivity analyses. *Results:* This study included 14 studies (18 arms, 793 patients). Pooled motor success was 78.3% (95% CI 72.4–83.8%; I^2 = 65.0%). Success definition was the sole significant modifier: 83.1% for ≤ 10 prism diopters (PD) exodeviation vs. 67.6% for ≤ 10/5 PD (P = 0.029). Reoperation rates (5 studies) ranged from 0–25%. *Conclusion:* Adult IXT surgery yields about 78% motor success, with variability primarily driven by inconsistent outcome definitions. Standardizing strict criteria and extending follow-up are essential to accurately characterize long-term outcomes.

Keywords: Intermittent exotropia; Adult; Strabismus surgery; Treatment outcome; Meta-analysis

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1. Introduction

Adult intermittent exotropia (IXT) surgery aims to restore alignment, binocular function, and psychosocial well-being [1–4]. However, adult outcomes remain poorly defined because most studies pool adult and pediatric data without stratification [2].

Reported success rates vary widely, driven partly by exotropic drift but more critically by inconsistent success definitions, with thresholds ranging from ≤ 10 prism diopters (PD) exodeviation alone to stricter criteria that also penalise > 5 PD esodeviation [5,6].

Lacking an adult-specific quantitative synthesis, we conducted this meta-analysis to estimate pooled motor success and reoperation rates in adult IXT. This study further evaluated how surgical technique, follow-up duration, and success definitions modify these outcomes.

2. Methods

This study followed PRISMA 2020 guidelines without prospective registration [7]. PubMed, Embase, and Scopus (inception–March 2026) were used to search for English-language original studies reporting surgical outcomes in adult (≥ 18 years) intermittent exotropia, supplemented by reference screening. Studies lacking separable adult data were excluded. Two independent reviewers performed screening, data extraction, and MINORS quality assessment, resolving discrepancies by consensus [8].

Primary and secondary outcomes were motor success and reoperation rates, respectively. Proportions were transformed using the Freeman-Tukey method and pooled via a random-effects model [9,10]. Heterogeneity was assessed with I^2 and Cochran Q [11]. This study performed predefined subgroup analyses (by procedure, follow-up, success threshold, study design, and quality) and sensitivity analyses. Publication bias was evaluated using Egger's regression [12]. Reoperations were summarized descriptively. Analyses were conducted in R [13,14].

3. Results

Following screening (**Figure 1**), 14 studies comprising 18 arms and 793 patients were included (**Table 1**) [15–28]. Median follow-up was approximately 9 months. Motor success was primarily defined as ≤ 10 PD exodeviation (11 arms) or a stricter ≤ 10 PD exodeviation / ≤ 5 PD esodeviation threshold (6 arms). The pooled motor success rate was 78.3% (95% CI 72.4–83.8%) (**Figure 2**), with moderate heterogeneity (I^2 = 65.0%, $p < 0.001$) and no evidence of publication bias (Egger's $p = 0.93$). Subgroup analysis revealed that the success definition was the only significant modifier: studies using the ≤ 10 PD criterion reported 83.1% success versus 67.6% for the stricter ≤ 10/5 PD criterion ($p = 0.029$). Follow-up duration showed a non-significant trend (< 12 months: 83.7% vs. ≥ 12 months: 75.0%; $p = 0.14$). Surgical procedure, study design, and MINORS quality did not significantly affect outcomes (all $p > 0.3$). Sensitivity analyses confirmed estimate stability (range 77.3–79.6%). Reoperation data (available in 5 studies) ranged from 0–25.0%, though the two largest cohorts both reported rates below 6%.

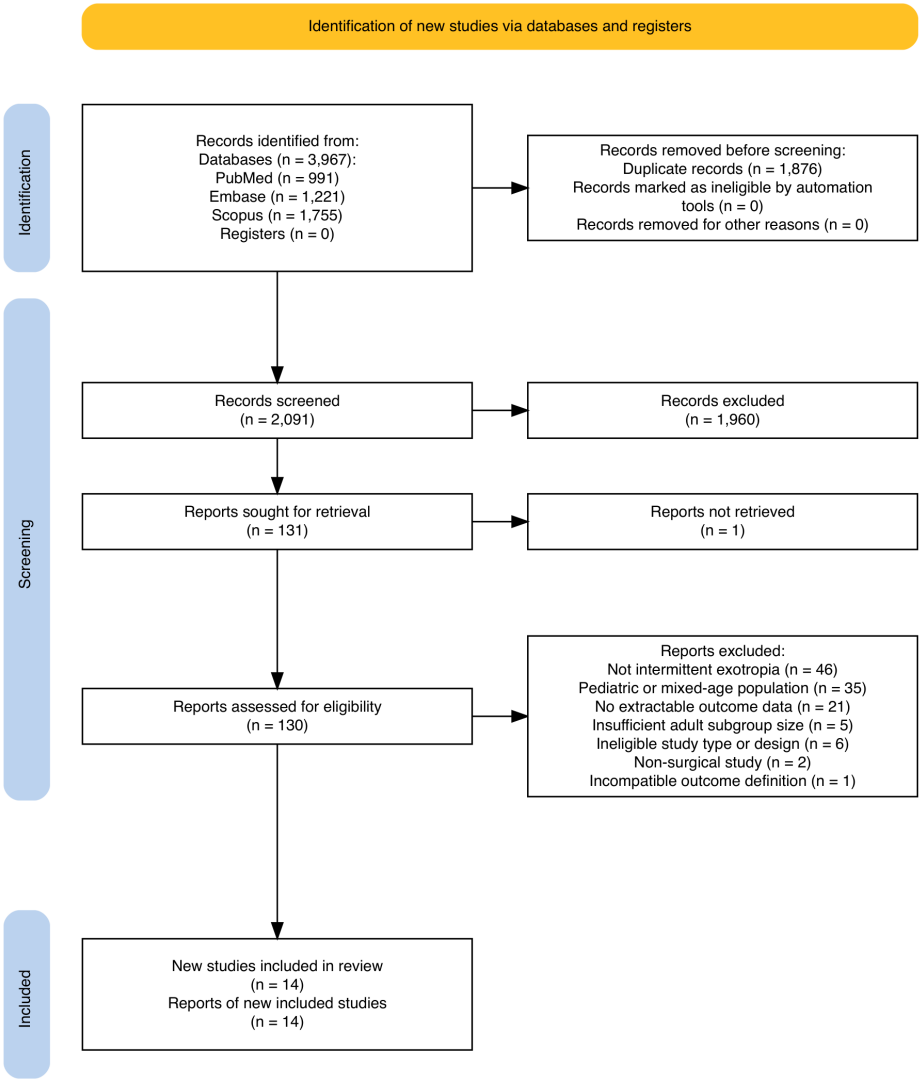

Figure 1. PRISMA 2020 flow diagram of the study selection process.

Table 1. Characteristics and motor success of the 14 included studies

Study	Country	Design	N	Age	Female (%)	IXT subtype	Proce dure	Adjus table sutures	Follow-up (months)	Success threshold (PD)	Motor success (%)
Choi (2001)	United States	Case series	20	53.1 ± 18.7	NR	CI	MR resection	Yes	8.7	≤ 10	75.0
Khazaeni (2006)	United States	Case series	60	48 (SD NR)	NR	Mixed	R&R	Yes	3	≤ 10	CI: 92.0; Basic: 100.0
Lau (2010)	Hong Kong, China	Case series	14	33.4 ± 12.8	NR	NR	3-muscle	No	13.1	≤ 10	85.7
Chalifoux (2016)	Canada	Retro cohort	60	45 (SD NR)	NR	NR	R&R	Yes	4–6	≤ 10	76.1
Kamlesh (2018)	India	RCT	40	24.5 ± 4.12	75	NR	BLRc vs BLRc	Yes vs No	3	≤ 10	Adj: 90.0; Non-adj: 85.0

Study	Country	Design	N	Age	Female (%)	IXT subtype	Proce dure	Adjus table sutures	Follow-up (months)	Success threshold (PD)	Motor success (%)
Lekskul (2018)	Thailand	Retro cohort	234	27.56 (SD NR)	52.1	Basic	R&R	NR	42.84	≤ 10	84.2
Choi (2019)	South Korea	Retro cohort	52	53.0 ± 9.46	61.5	Mixed	Mixed	Yes (78.8%)	71.96	≤ 10 exo / ≤ 5 eso	82.7
Yao (2019)	China	Prosp cohort	34	NR	NR	NR	Mixed	NR	1	≤ 10	94.7
Anand (2020)	India	RCT	34	NR	NR	Basic	RP vs R&R	No	12	≤ 10 exo / ≤ 5 eso	RP: 68.4; RR: 73.3
Lekskul (2021)	Thailand	Prosp cohort	36	NR	NR	NR	ULRc	No	3	≤ 8	80.0
Mattout (2022)	Egypt	Retro cohort	51	27.5 ± 5.86	47.6	Mixed	BTA+ BLRc vs 3-muscle	NR	12	≤ 10 exo / ≤ 5 eso	BTA: 47.6; 3-muscle: 66.7
Narayan (2023)	UK	Retro cohort	93	37.4 ± 20.2	55	Mixed	R&R	NR	8.7	≤ 10 exo / ≤ 5 eso	61.3
Srimanan (2025)	Thailand	Retro cohort	43	35.7 ±14.6	41.9	Mixed	Mixed (R&R 79%)	Mixed (9.3%)	12	≤ 10	74.4
Wang (2026)	United States	Retro cohort	98	NR	NR	Mixed	Mixed	NR	NR	≤ 10	69.4

For multi-arm studies, motor success is reported per arm. N = number of patients; IXT = intermittent exotropia; R&R = unilateral recession–resection; BLRc = bilateral lateral rectus recession; RP = plication; ULRc = unilateral lateral rectus recession; BTA = botulinum toxin A; PD = prism diopters; exo = exodeviation; eso = esodeviation; NR = not reported.

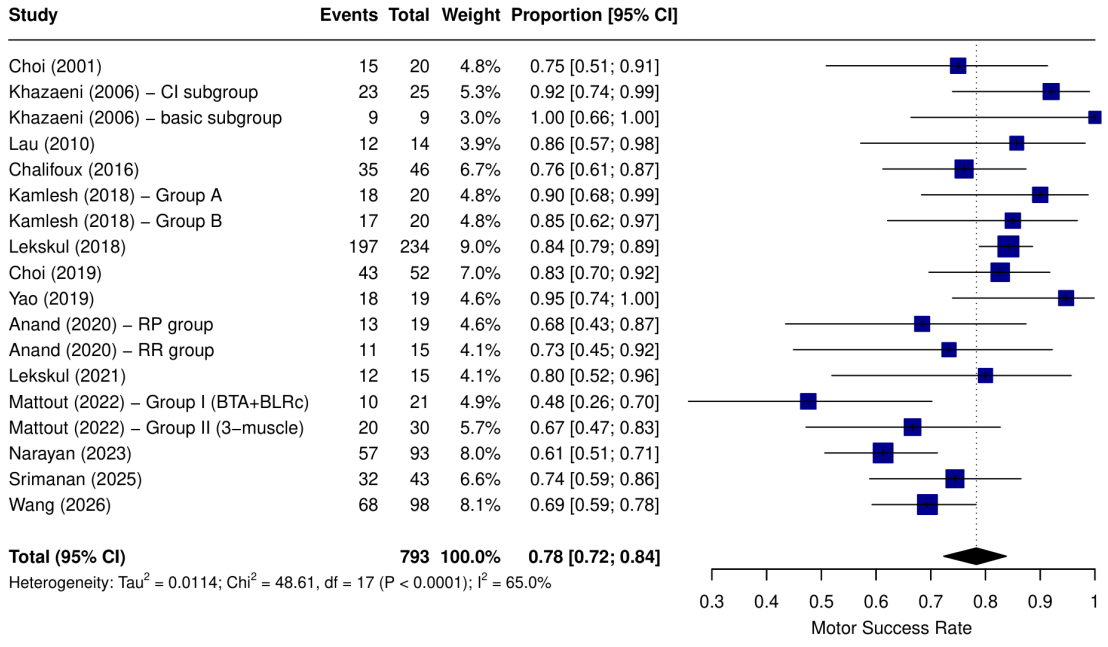

Figure 2. Forest plot of pooled motor success rate. Squares indicate individual estimates (size proportional to weight); the diamond shows the pooled estimate.

4. Discussion

Adult IXT surgery achieves an overall motor success rate of around 78%. However, this average hides substantial heterogeneity. This variation is driven by inconsistent success definitions rather than surgical techniques. Permissive criteria (≤ 10 PD exodeviation) overstate success by > 15% compared to strict thresholds that also classify > 5 PD esodeviation as failure. This distinction is clinically important. Unlike children who readily suppress, adults risk persistent diplopia from surgical overcorrection [2,29]. Therefore, permissive criteria can ignore significant postoperative problems [30]. Adopting strict, asymmetric motor thresholds is necessary to accurately evaluate adult outcomes [31]. Furthermore, current literature often underestimates long-term surgical failure. The decline in success beyond 12 months reflects continuous postoperative exotropic drift [32]. Because of this drift, the low reoperation rates (< 6%) reported across a short 9-month median follow-up likely underestimate the true surgical burden.

Limitations include the predominantly retrospective evidence base and the absence of patient-reported quality-of-life data, precluding assessment of the full psychosocial and functional impact of surgery [31].

5. Conclusion

Adult IXT surgery yields around 78% motor success rate, but substantial heterogeneity stems directly from how success is defined. Future studies must standardize these criteria and extend follow-up to better characterize adult-specific outcomes.

Disclosure statement

The authors declare no conflict of interest.

References

[1] Schlossman A, Muchnick R, Stern K, 1983, The Surgical Management of Intermittent Exotropia in Adults. Ophthalmology, 90(10): 1166–1171.

[2] Jeong S, Han S, Kim W, 2024, The Comparison of Postoperative Changes in Subjective Awareness of Exodeviation Between Pediatric and Adult Patients with Intermittent Exotropia. Medicine, 103(25): e38696.

[3] Hatt S, Leske D, Holmes J, 2010, Responsiveness of Health-Related Quality-of-Life Questionnaires in Adults Undergoing Strabismus Surgery. Ophthalmology, 117(12): 2322–2328.e1.

[4] Mills M, Coats D, Donahue S, et al., 2004, Strabismus Surgery for Adults: A Report by the American Academy of Ophthalmology. Ophthalmology, 111(6): 1255–1262.

[5] Kopmann S, Grenzebach U, Ehrt O, et al., 2024, Effectiveness of Strabismus Surgery in Intermittent Exotropia and Factors Influencing Outcome. Journal of Clinical Medicine, 13(4): 1031.

[6] Xu M, Peng Y, Zheng F, et al., 2023, The Effects of Orthoptic Therapy on the Surgical Outcome in Children with Intermittent Exotropia: Randomised Controlled Clinical Trial. Journal of Clinical Medicine, 12(4): 1283.

[7] Page M, McKenzie J, Bossuyt P, et al., 2021, The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews. BMJ, 372: n71.

[8] Slim K, Nini E, Forestier D, et al., 2003, Methodological Index for Non-Randomized Studies (MINORS):

Development and Validation of a New Instrument. ANZ Journal of Surgery, 73(9): 712–716.

[9] Freeman M, Tukey J, 1950, Transformations Related to the Angular and the Square Root. Annals of Mathematical Statistics, 21(4): 607–611.

[10] DerSimonian R, Laird N, 1986, Meta-Analysis in Clinical Trials. Controlled Clinical Trials, 7(3): 177–188.

[11] Higgins J, Thompson S, 2002, Quantifying Heterogeneity in a Meta-Analysis. Statistics in Medicine, 21(11): 1539–1558.

[12] Egger M, Davey Smith G, Schneider M, et al., 1997, Bias in Meta-Analysis Detected by a Simple, Graphical Test. BMJ, 315(7109): 629–634.

[13] Balduzzi S, Rücker G, Schwarzer G, 2019, How to Perform a Meta-Analysis With R: A Practical Tutorial. Evidence-Based Mental Health, 22(4): 153–160.

[14] Viechtbauer W, 2010, Conducting Meta-Analyses in R With the Metafor Package. Journal of Statistical Software, 36(3): 1–48.

[15] Choi D, Rosenbaum A, 2001, Medial Rectus Resection(s) With Adjustable Suture for Intermittent Exotropia of the Convergence Insufficiency Type. Journal of AAPOS, 5(1): 13–17.

[16] Khazaeni L, Volpe N, 2006, Adjustable Medial Rectus Muscle Resection in Adult Exotropia. Journal of Pediatric Ophthalmology and Strabismus, 43(4): 225–229.

[17] Lau F, Fan D, Yip W, et al., 2010, Surgical Outcome of Single-Staged Three Horizontal Muscles Squint Surgery for Extra-Large Angle Exotropia. Eye, 24(7): 1171–1176.

[18] Chalifoux E, Alkharashi M, Superstein R, et al., 2016, Adjustable Surgical Treatment of Adult Exotropia: Postoperative Target Angles and Surgical Success. Canadian Journal of Ophthalmology, 51(4): 254–257.

[19] Kamlesh K, Babu S, Goel Y, et al., 2018, Comparison of Adjustable Sutures Versus Nonadjustable Sutures in Intermittent Exotropia. European Journal of Ophthalmology, 28(3): 264–267.

[20] Lekskul A, Supakitvilekarn T, Padungkiatsagul T, 2018, Outcomes of Undercorrection in Surgical Management and Binocular Vision Gained of Adult Intermittent Exotropia. Clinical Ophthalmology, 12: 1763–1767.

[21] Choi D, Noh H, Park K, et al., 2019, Survival Analysis of Adult and Children Intermittent Exotropia Using a Matched Case-Control Design. Scientific Reports, 9(1): 575.

[22] Yao J, Qu X, Lin J, et al., 2019, Does Successful Surgical Correction of Childhood Large Angle Exotropia in Adults Make Any Difference to Binocularity and Quality of Life? Strabismus, 27(3): 149–155.

[23] Anand K, Baindur S, Dhiman S, et al., 2020, Surgical Outcomes of Plication Versus Resection in Basic Type of Intermittent Exotropia. Canadian Journal of Ophthalmology, 55(4): 323–329.

[24] Lekskul A, Wuthisiri W, Jarupanich N, 2021, A Prospective Study of One-Muscle Surgery in 15–25 Prism Diopters Horizontal Comitant Strabismus in Adults. Clinical Ophthalmology, 15: 3669–3678.

[25] Mattout H, Fouda S, El-Haig W, 2022, Botulinum Toxin Augmented Bilateral Lateral Rectus Recession Versus Three Muscles Surgery in Large-Angle Intermittent Exotropia. International Journal of Ophthalmology, 15(10): 1665–1670.

[26] Narayan A, Dosanjh S, Dominic J, 2023, Early Post-Operative Angle as a Predictor of Surgical Success in Adult Patients with Intermittent Exotropia. Strabismus, 31(2): 152–158.

[27] Srimanan W, Keokajee P, 2025, Early Postoperative Alignment and Preoperative Stereopsis as Determinants of Success in Intermittent Exotropia Surgery. PLOS ONE, 20(10): e0329609.

[28] Wang J, Tibi C, McKeown C, et al., 2026, Surgical Outcomes of Intermittent and Constant Exotropia in an Adult Population Between 18 and 60 Years Old. British Journal of Ophthalmology, 2026 Jan 5: bjo-2025-328132.

[29] Choi S, Kim M, Oh J, 2018, Long-Term Surgical Outcomes of Initial Postoperative Overcorrection in Adults with Intermittent Exotropia. Korean Journal of Ophthalmology, 32(3): 228–233.

[30] Martín-Begué N, Ruiz-Manrique H, Alarcón Martínez M, 2025, Surgical Outcomes and Etiological Considerations in Intermittent Exotropia: A Systematic Narrative Review. Strabismus, online ahead of print.

[31] Hatt S, Leske D, Holmes J, 2012, Comparing Outcome Criteria Performance in Adult Strabismus Surgery. Ophthalmology, 119(9): 1930–1936.

[32] Heo H, Sung M, Park S, 2014, Survival Analysis Following Early Surgical Success in Intermittent Exotropia Surgery. International Journal of Ophthalmology, 7(3): 528–533.