

The comparison of interrupted and continuous suturing technique in Snodgrass urethroplasty in patients with primary hypospadias: A systematic review and meta-analysis

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Abstract

Background: Hypospadias is among the common congenital anomalies in boys. Snodgrass urethroplasty is one of the most popular techniques for correcting distal and mid hypospadias. Although there is consensus among pediatric surgeons on using absorbable sutures for urethroplasty, there are no established guidelines about the suturing techniques (interrupted suturing [IS] or continuous suturing [CS]) for neourethra creation in Snodgrass urethroplasty. This analysis aims to compare the reported outcomes of both the urethroplasty suturing techniques.

Materials and Methods: This systematic review and meta-analysis was conducted as per the preferred reporting items for systematic review and meta-analyses guidelines. A systematic, detailed search was carried out by the authors in the electronic databases – MEDLINE, PubMed Central, Scopus, Google Scholar, and Clinical Trial Registry. Studies were selected and compared based on primary outcomes – development of urethrocutaneous fistula (UCF), meatal stenosis, and secondary outcomes – wound infection, urethral stricture, and operative time. Statistical analysis was performed using a fixed-effect model, pooled risk ratio, and I^2 heterogeneity.

Results: Five randomized studies with a total of 521 patients met our inclusion criteria. Pooled analysis for total complications, UCF, meatal stenosis, and wound infection showed no significant difference between the CS and IS groups. Subgroup analysis of patients with the use of polyglactin sutures showed a decrease in total complications and UCF in the IS group.

Conclusion: There is no difference in total complication rates among the CS and the IS group with the use of absorbable sutures in Snodgrass urethroplasty; however, there is a decrease in the incidence of total complications and UCF in the IS group when polyglactin was preferred over polydioxanone suture for urethroplasty.

Keywords: Meta-analysis, Snodgrass urethroplasty, suturing technique

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INTRODUCTION

Hypospadias is one of the most common congenital anomalies encountered in boys. The reported incidence of hypospadias is 1 in 150–300 live births.^[1] It is diagnosed by the classic triad of the hooded prepuce, ventral advancement of the urethral meatus, and ventral penile curvature signifying the arrest in the penile development.^[1] The goal of primary hypospadias repair includes correction of penile curvature, advancement of urethral meatus to ensure satisfactory passage of urine and semen through the glans, and creation of a cosmetically pleasing penis.^[1] The repair techniques can be broadly categorized as procedures utilizing local skin flaps, preputial and extragenital tissue grafts/flaps, and urethral tubularization.^[1] More than 200 variations of hypospadias repair have been described in English literature, among which the tubularized incised plate (TIP) urethroplasty, introduced by Warren Snodgrass in 1994, has revolutionized the surgical management of hypospadias.^[1,2] This technique aims to correct distal hypospadias with minimal chordee by tubularizing the incised urethral plate.^[2] The fundamental step of this procedure is a deep longitudinal incision of the native urethral plate, which allows tubularization without the need for additional flaps or grafts.^[2] The Snodgrass repair has gained worldwide acceptance for primary distal and even for selected cases of primary proximal hypospadias.^[3] A survey among pediatric urologists identified that the TIP technique was preferred in more than 90% of cases of distal and 80% of midshaft hypospadias repair.^[4] There is consensus on using absorbable sutures for neourethra creation during hypospadias repair; however, no specific guidelines for the suturing technique in hypospadias repair are available.

Despite the apparent surgical success of TIP, few complications still exist. Although these complications are few, they can be evaluated and eliminated if they relate to the suturing technique. Neourethra is created with absorbable sutures using either continuous suturing (CS) or interrupted (intermittent) suturing (IS). Although Snodgrass *et al.*^[5] reported no difference in outcomes regardless of the suturing technique, results from other authors such as Samir *et al.*^[6] and Gafar *et al.*^[7] have incited us to look into the significance of suturing technique. Ulman *et al.*^[8] first reported that the subcuticular continuous suture technique was associated with a lower incidence of urethrocutaneous fistula (UCF) in Mathieu repair. Gupta *et al.*^[9] reported that suturing technique had no significant effect on complications following Snodgrass repair. Variations in the surgical techniques can affect the

functional outcome of hypospadias repair.^[9] As both CS and IS techniques are variably used, this study systematically compares the reported outcomes of both techniques.

MATERIALS AND METHODS

This systematic review and meta-analysis was conducted as per the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines.^[10] A preliminary literature search was done in PubMed Central to confirm the absence of similar published meta-analyses. A systematic, detailed search was carried out in the electronic database including MEDLINE, CENTRAL (Cochrane Central Register of Controlled Trials), Scopus, and Google Scholar by two authors (CT and AD) independently till May 2022. The Clinical Trial Registry (clinicaltrials.gov) and the major conference proceedings were searched till May 2022, with no language restrictions. Searches were rerun before the final analysis. The search terms used were (continuous suturing OR interrupted suturing OR intermittent suturing) AND (tubularized incised plate urethroplasty OR Snodgrass urethroplasty). Hand searches were also conducted along with related references listed in the studies.

Eligibility criteria

Randomized control trials and comparative studies were included in our meta-analysis. Participants/population was defined as patients who have undergone Snodgrass urethroplasty. The intervention was CS and the comparator was IS. The inclusion criteria were the patients who had undergone Snodgrass urethroplasty. The patients undergoing hypospadias repair by techniques other than the Snodgrass technique, Snodgrass repair performed for secondary hypospadias, and stentless urethroplasty were excluded. The primary outcome measures were the development of complications like UCF and meatal stenosis. The secondary outcome measures were wound infection, urethral stricture, and operative time.

Data collection and analysis

Study selection

Two authors (S.S. and N.B.) independently reviewed for abstract and title of the identified article. All potentially relevant articles were reviewed as full text. Whenever there were differences in opinion, it was resolved by a third author (D.M.).

Quality assessment

The critical appraisal of methodological quality was performed by two authors (C.T. and D.M.) using the Modified Downs and Black scale.^[11] We also measured the Kappa coefficient to estimate the inter-rater reliability for included studies for the Downs and Black scale.^[12]

Data extraction

After the selection of the relevant studies, data extraction was performed by two authors (S.S. and A.D.) independently. The baseline information of each study (information of the author, year of publication), number of patients in each study, number of patients in each group, mean/median age, and age range of the included patients along with the abovementioned outcomes were extracted in a data extraction table using MS Excel (version 16.16.27). The inter-observer discrepancies were resolved through consensus and consultation with the senior author (N.B.).

Risk of bias assessment

This assessment was done by two authors (N.B. and C.T.) independently using the Cochrane collaboration's tool for randomized studies.^[13]

Statistical analysis

Dichotomous outcome effects were expressed as risks ratio (RR), with 95% confidence intervals (CI). Continuous outcome variable effects were expressed as a mean difference with 95% CI. The individual was the preferred unit of analysis. The heterogeneity of the studies was identified by visual assessment of the CI of the studies in the forest plot (eyeball test). Heterogeneity was examined explicitly with I^2 statistics. A rough guide to the interpretation of I^2 in the context of meta-analyses of randomized trials is as follows: 0%–40%: might not be significant; 30%–60%: may represent moderate heterogeneity, 50%–90%: may represent substantial heterogeneity, and 75%–100%: considerable heterogeneity.^[14]

RESULTS

The literature search yielded a total of 211 studies. The PRISMA flow diagram demonstrates our search and selection process^[10] [Figure 1]. After removing the duplicate studies, 182 records were screened for title and abstract. A total of 11 articles were retrieved for full-text screening, following which only five randomized studies were included for the evaluation.

Study characteristics – the characteristics of the included study is summarized in Table 1.

Five studies^[6,7,9,15,16] met our inclusion criteria, including 521 children (258 in the CS group and 263 in the IS group).

Risk of bias within the studies

A trial by Samir *et al.*^[6] has shown a low risk of bias across random sequence generation, blinding of outcome assessment, and selective reporting. Gupta *et al.*^[9] has shown low risk across all domains except blinding of the

participants. The allocation concealment was mentioned only by Gafar *et al.*^[7] and Gupta *et al.*,^[9] which is unclear for the other three studies. All included studies generated a random sequence for allocation of the participants.

Results of individual studies

Postoperative complications reported in each study are summarized in Table 2.

Methodological quality assessment

Modified Down and Black scores assigned to each study by two authors are depicted in Table 3. The score ranges from 15 to 25. The study by Samir *et al.* has the maximum score, and the study by Shibli MMR *et al.* has the least score. There is a very high inter-rater agreement between rater 1 and rater 2 with a Kappa of 0.99.

Urethrocuteaneous fistula

The development of postoperative UCF has been reported in all the included studies. All studies have provided split data among the CS and IS groups for Snodgrass repair, except for Sarhan *et al.*^[15] who reported eight UCF among the 80 participants without division among the groups. In the other four studies, there were 28 UCF in 218 patients (12.84%) in the CS group and 17 UCF in 223 patients (7.6%) in the IS group. The UCF division between IS and CS groups has not been reported by Sarhan *et al.*,^[15] leading to the noninclusion of this study in the pooled analysis. Pooled analysis of the rest four studies^[6,7,9,16] showed no significant difference in the incidence of UCF among IS and CS groups (RR 1.68, 95% CI: 0.95–3.38). There was no significant heterogeneity observed between the studies ($I^2 = 21%$) [Figure 2.1]. Among all four studies included for the pooled analysis, three studies^[6,9,16] have used polyglactin as the suture of choice for neourethra construction. In contrast, Gafar *et al.*^[7] used polydioxanone for neourethra construction. We have excluded this study of Gafar *et al.*^[7] from the subgroup analysis of polyglactin suture in Snodgrass urethroplasty. Among the three studies,^[6,9,16] there were 27 UCF in 178 patients (15.16%) in the CS group and 14 UCF in 183 patients (7.6%) in the IS group. Pooled analysis of these studies in which polyglactin was used for neourethra construction suggests that there is less incidence of UCF in the IS group (RR 1.97, 95% CI: 1.97–3.61, $P = 0.03$). There was no heterogeneity observed between the studies ($I^2 = 0%$) [Figure 2.2].

Gafar *et al.*^[7] reported an increased incidence of UCF in the IS group compared to the CS group with polydioxanone sutures, but the difference was statistically insignificant.

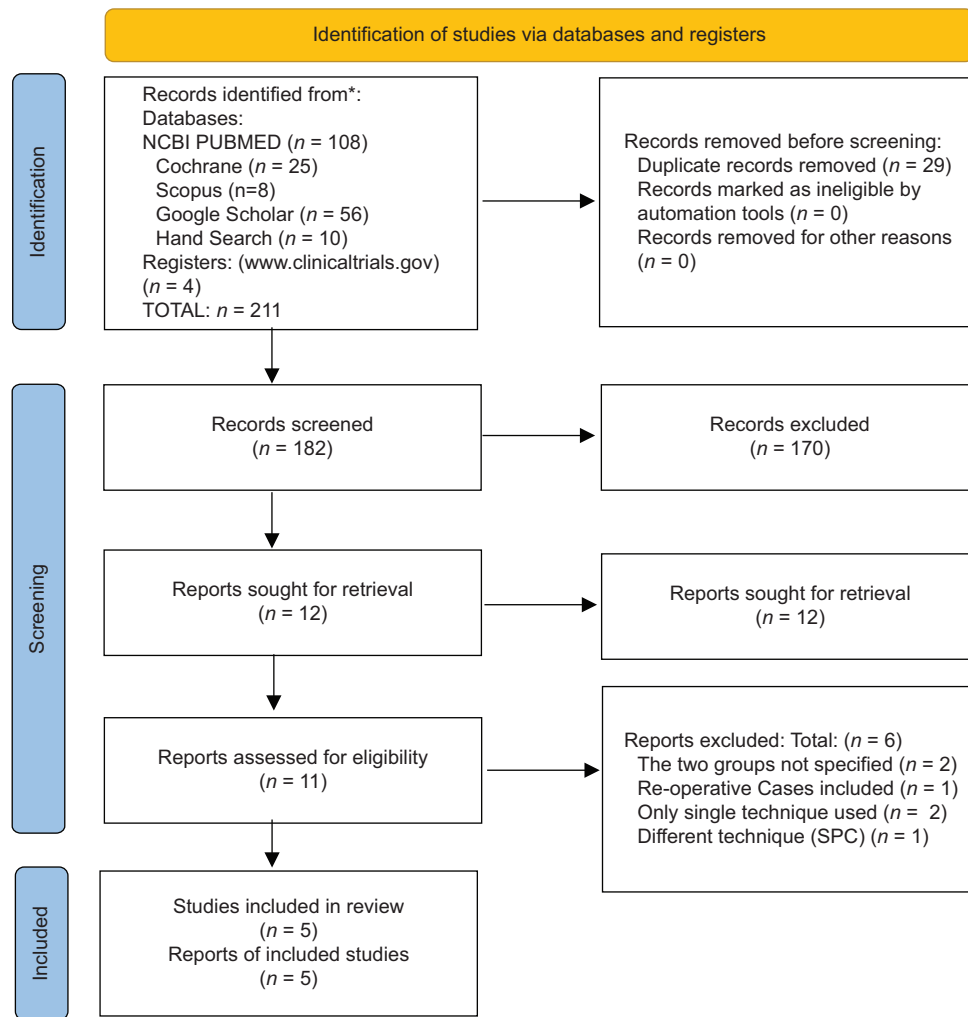


Figure 1: PRISMA flow diagram, PRISMA: Preferred Reporting Items for Systematic Review and Meta-Analyses

Meatal stenosis

Meatal stenosis has been reported in all five studies. Sarhan *et al.*^[15] reported three patients developing MS among the 80 participants in their study. They have not specified their patients' group-wise (CS and IS) incidence of MS. Hence, this study was not considered for pooled analysis. In the rest four studies, the incidence of MS was eight (3.6%) in the CS group ($n = 218$) and six (2.6%) in the IS group ($n = 223$). Pooled analysis of these four studies^[6,7,9,16] showed no significant difference in the incidence of MS among IS and CS groups (RR 1.33, 95% CI: 0.49–3.61). There was no heterogeneity observed between the studies ($I^2 = 0\%$). Three of the four studies included pooled analysis and used polyglactin for neourethra construction. The study by Gafar *et al.* was excluded from the subgroup analysis of MS due to the use of polydioxanone sutures. In the other three studies,^[6,9,16] the incidence of MS was eight (4.4%) in the CS group ($n = 178$) and four (2.2%) in the IS group ($n = 183$). Pooled analysis of the studies in which polyglactin was used for neourethra construction showed

no significant difference in the incidence of MS among IS and CS groups (RR 2.04, 95% CI: 0.63–6.60). There was no observed heterogeneity between the studies ($I^2 = 0\%$). Gafar *et al.*^[7] reported the incidence of MS only in the IS group but with no statistically significant difference in the two groups using polydioxanone sutures in TIP.

Total complications

Fifty-three (20.5%) complications among the 258 patients in the CS group and 41 (15.8%) complications among the 263 patients in the IS group were observed. Pooled analysis of all five studies showed no significant difference in total complication rates among both the groups (RR 1.32, 95% CI: 0.91–1.91); however, there is substantial heterogeneity between the studies ($I^2 = 55\%$) [Figure 2.3]. We performed a subgroup analysis of four studies that have used polyglactin for neourethra construction. We have excluded the study of Gafar *et al.*^[7] due to the use of polydioxanone. We calculated a total of 52/218 (23.8%) complications in the CS group and 34/223 (15.2%) complications in the IS group. Pooled

Table 1: Baseline characteristic of all included studies

Studies	Setting	Study period	Design	Patients (n)	Mean age (months)	Type of hypospadias	Suturing technique	F/U (months)	Reported outcomes
Sarhan <i>et al.</i> ^[15]	Egypt	January 2004– May 2005	RCT	Total 80; 40 in each group	4.5 years (range being 3–7 years)	Anterior or mid-penile	Group A: 40 patients: Continuous closure Group B: 40 patients: Interrupted closure Second layer: Dartos flap 6-0 and 7-0 polyglactin	36 months (24–54)	Complication rate UCF Dehiscence MS
Shibli <i>et al.</i> ^[16]	Bangladesh	June 2008– September 2009	RCT	Total 32; 16 in each group	A: 5.36±3.46 (years) B: 6.14±3.57 (years)	Distal penile	Group A: 16 patients: Interrupted closure Group B: 16 patients: Continuous closure Second layer: Dartos flap Suture: 7-0 polyglactin	1 month	UCF MS
Gafar <i>et al.</i> ^[7]	Egypt	January 2009– December 2011	RCT	Total 80; 40 in each group	A: 8–48 B: 8–42	Distal penile	Group A: 40 patients: Continuous closure Group B: 40 patients: Interrupted closure Second layer: Dartos flap Suture: 5-0 and 6-0 polydioxanone	A: 7.7±2.5 B: 8.5±2.5	UCF MS Wound infection
Gupta <i>et al.</i> ^[9]	India	October 2010–March 2015	RCT	Total 100; 50 in each group	26.2 (12–66)	Subcoronal Distal Mid-penile	Group A: 50 patients: Interrupted closure Group B: 50 patients: Continuous closure Second layer: Dartos flap Suture: 6-0 polyglactin	Not mentioned	Operative time UCF Partial superficial wound dehiscence MS Stricture Urinary stream Aesthetic appearance
Samir <i>et al.</i> ^[6]	Egypt	February 2018– December 2020	RCT	Total 229; (112 and 117 in both groups)	A: 27 (22–31) B: 26 (22–32)	Subcoronal Distal Mid-penile	Group A: 112 patients: Continuous closure Group B: 117 patients: Interrupted closure Second layer: Dartos flap Suture: 6-0 polyglactin	Not mentioned in the results	UCF PSWI PGD MS Urethral stricture

RCT: Randomized controlled trial, UCF: Urethrocutaneous fistula, MS: Meatal stenosis, F/U: Follow-up, PGD: Partial glans dehiscence, PSWI: Partial superficial wound infection

Table 2: Summary outcome table

Study	Technique	Total (n)	UCF	MS	Stricture	PGD	PSWI	Mean operative time (min)	Overall late complication rate
Sarhan <i>et al.</i> ^[15]	CS	40	8	3	-	2	-	-	5
	IS	40	-	-	-	-	-	-	6
Shibli <i>et al.</i> ^[16]	CS	16	6	3	-	-	-	-	9
	IS	16	2	1	-	-	-	-	3
Gafar <i>et al.</i> ^[7]	CS	40	1	0	-	-	0	58±7.7	1
	IS	40	3	2	-	-	2	60.5±7.4	7
Gupta <i>et al.</i> ^[9]	CS	50	7	1	1	1	1	132.4	11
	IS	50	6	1	1	1	1	139	10
Samir <i>et al.</i> ^[6]	CS	112	14	4	2	5	3	-	27
	IS	117	6	2	1	2	3	-	15

UCF: Urethrocutaneous fistula, MS: Meatal stenosis, PGD: Partial glans dehiscence, PSWI: Partial superficial wound infection, CS: Continuous suturing, IS: Interrupted suturing

analysis showed that total complications are less in the IS group (RR 1.56, 95% CI: 1.06–2.30) with insignificant heterogeneity between the studies ($I^2 = 21%$) [Figure 2.4].

Urethral stricture

Only two studies have reported this complication. Gupta *et al.*^[9] reported one patient with stricture in each group, whereas Samir *et al.*^[6] reported strictures in two patients in the CS group and one in the IS group. Pooled analysis of these two studies shows no significant difference regarding

stricture formation among the groups (RR 1.54, 95% CI: 0.26–9.05).

Partial superficial wound infection (PSWI): this complication was reported in three studies. Samir *et al.*^[6] reported three patients with PSWI in each group. Gupta *et al.*^[9] reported one PSWI in each group, whereas Gafar *et al.*^[7] reported two PSWI in the IS group. Pooled analysis of these two studies shows no significant difference regarding PSWI among the groups (RR 0.71, 95% CI: 0.22–2.32).

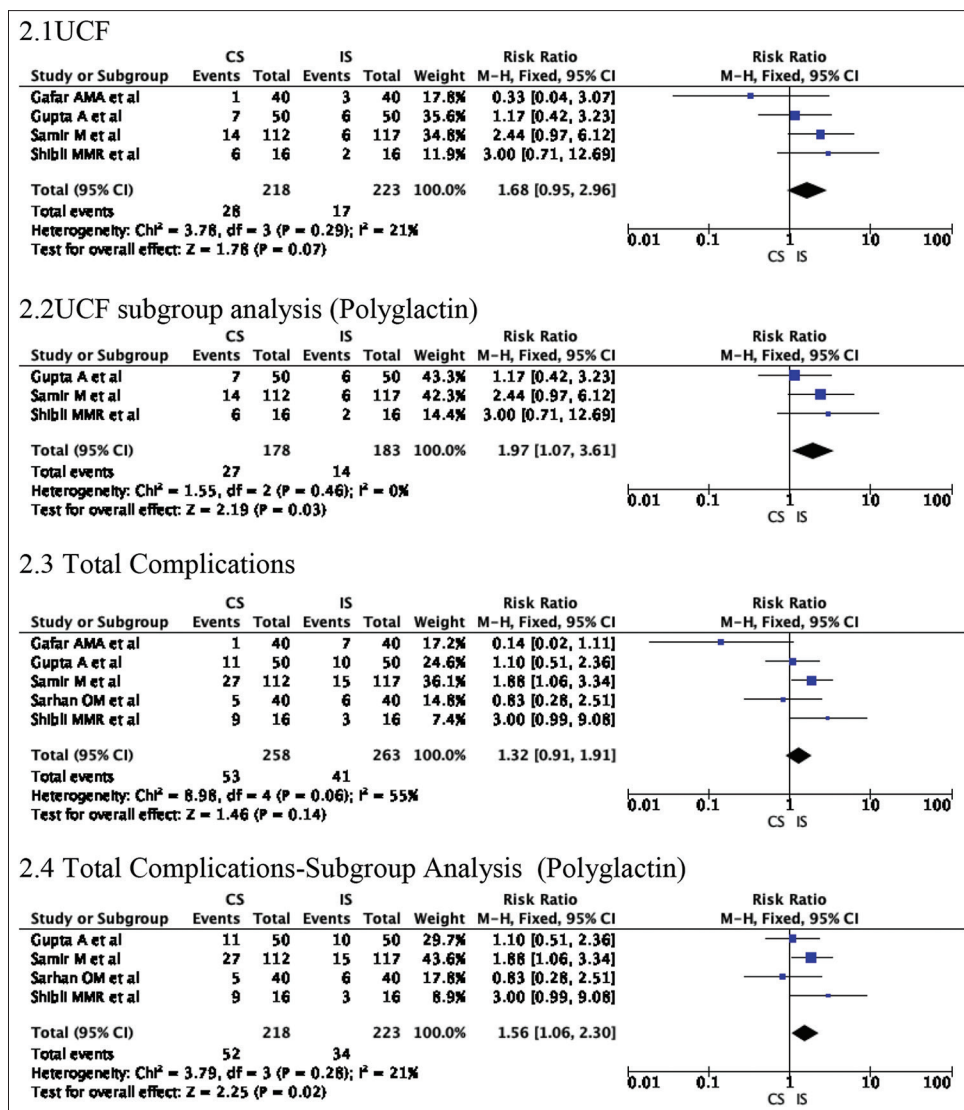


Figure 2: Forest plots

Table 3: Down and Black Scale scores for the included studies and inter-observer agreement (Kappa statistics)

Study	Rater 1	Rater 2	Kappa
Sarhan et al. ^[15]	16/28	17/28	0.99
Shibli et al. ^[16]	15/28	17/28	
Gafar ^[7]	21/28	22/28	
Gupta et al. ^[9]	23/28	24/28	
Samir et al. ^[6]	25/28	25/28	

Gafar et al.^[7] and Gupta et al.^[9] have reported mean operative time. We observed a vast difference between the reported mean time of both. Both studies have reported that the difference between mean operative time in the IS and the CS group was statistically insignificant.

Although the studies had reported glans dehiscence, we have not included it in the pooled analysis, as a recent review identified various other factors responsible for glans dehiscence apart from the suture technique.^[17]

DISCUSSION

Snodgrass urethroplasty is one of the most versatile techniques among the described techniques for hypospadias.^[9] It is an easily reproducible technique with good cosmetic results.^[9] There is no consensus on the suturing technique in Snodgrass urethroplasty. Various suturing techniques have also been studied in bowel anastomosis, brachiocephalic anastomosis, hepaticojejunostomy, and oral and nasal mucosal repair.^[18-21] The results of these studies are pretty variable, not favoring any one technique. Theoretically, CS takes less time for suturing than IS but can have a higher complication rate due to tissue strangulation and ischemia due to tissue entrapment between the running sutures.^[6]

Principal findings

This meta-analysis is the first comprehensive evidence of the currently available comparison between the IS

and CS techniques for creating neourethra in Snodgrass urethroplasty. Only five studies met the inclusion criteria set for our meta-analysis, involving a total of 521 children. When we consider the included studies for pooled analysis of total complications, the result suggests that the total complications are more in the CS group; however, the difference between the groups (IS and CS) is not statistically significant. Subgroup analysis for total complications in the four studies using polyglactin for neourethra creation suggests that total complications are less in the IS group with insignificant heterogeneity.

The incidence of UCF in the CS group is 12.84% and 7.6% in the IS group. The incidence of UCF between the IS and the CS group was not separately reported by Sarhan *et al.*,^[15] leading to noninclusion in the pooled analysis. Pooled analysis of the four studies showed no significant difference in the incidence of UCF among the IS and the CS group, even though the incidence of UCF is higher in the CS group with no significant heterogeneity. Gafar *et al.*^[7] used polydioxanone, whereas the other three studies used polyglactin for neourethra creation. The subgroup analysis of the three studies suggests a reduced incidence of UCF among the IS group, with no heterogeneity observed between the studies.

Pooled analysis of four studies excluding Sarhan *et al.*^[15] and subgroup analysis of three studies excluding Gafar *et al.*^[7] for MS does not show any statistically significant difference between the (IS and CS) groups. Pooled analysis of the studies for other complications like stricture and PSWI shows no statistically significant difference.

Limitation and strength of the study

Out of the five studies recruited for this metanalysis, three are from Egypt (Africa), and the rest two are from Asia (India and Bangladesh). We were unable to find similar studies from other continents.

Only one of the included studies has reported polydioxanone for neourethra creation, leading to its exclusion from the subgroup analysis. Our study has a moderate risk of bias with selective reporting of few secondary outcomes.

Another limitation is the smaller number of randomized controlled trials (RCTs) included in the meta-analysis. Only five RCTs were available for the pooled outcome analysis and four for other subgroup analyses. Hence, the results based on pooled analysis should be used with caution due to the smaller number of available RCTs.

The strength of our meta-analysis is the inclusion of only RCTs, considered the best available form of evidence in the literature.

CONCLUSION

This meta-analysis shows no significant difference in the total complication rates, including UCF in the CS and the IS groups with absorbable suture use in Snodgrass urethroplasty. Our meta-analysis shows a reduction in the incidence of total complications and UCF in the IS group when polyglactin suture is used for urethroplasty.

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Conflicts of interest

There are no conflicts of interest.

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