Is Cesarean Section Protective against Anal Incontinence in Women after Obstetric Anal Sphincter Injury (OASI)? A Systematic Review and Meta-Analysis

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Abstract

Objective: Approximately 50% women who give birth after Obstetric Anal Sphincter Injury (OASI) develop anal incontinence (AI) over their lifetime. We review current evidence for protective benefit of planned cesarean section (CS) to prevent AI after OASI. Design and setting: Systematic review and meta-analysis according to prospectively published methodology. Population and methods: All studies reporting outcomes after an OASI and subsequent birth by any mode. Main outcome measures: AI measurement after OASI and subsequent birth. Total AI, new/worsening AI, quality of life, satisfaction, regret. Results: 86 of 2472 screened studies met inclusion criteria. All studies contributing to meta-analyses were at high risk of bias. There was no evidence of difference in new or worsening AI after subsequent vaginal birth (VB) compared to subsequent CS after OASI across all time periods (p=0.53: CI 0.72-1.19; 9 studies, 2104 participants); [?]2y (p=0.83: CI 0.65-1.72; 7 studies, 569 participants) or [?]5y after subsequent birth (p=0.39: CI 0.65-1.18; 2 studies; 1535 participants). There was no difference between subsequent CS or VB in asymptomatic women or for other AI or QOL outcomes. There was no evidence of difference in AI in women who subsequently delivered vs those who did not (p=0.9: CI 0.71-1.34; 10 studies, 970 participants); or pre- subsequent birth vs post-subsequent birth (p=0.31; CI 0.51-1.25, 13 studies, 5496 participants). Conclusions: Due to evidence quality (majority non-randomised studies) we are unable to determine whether planned cesarean is protective against AI after OASI. Higher quality data is required to guide practice in this area, specifically in asymptomatic women and for long-term outcomes.

Title page

Is Cesarean Section Protective against Anal Incontinence in Women after Obstetric Anal Sphincter Injury (OASI)? A Systematic Review and Meta-Analysis

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Shortened running title:

Mode of Birth after OASI and Anal Incontinence, A Systematic Review.

Abstract

Objective:

Approximately 50% women who give birth after Obstetric Anal Sphincter Injury (OASI) develop anal incontinence (AI) over their lifetime. We review current evidence for protective benefit of planned cesarean section (CS) to prevent AI after OASI.

Design and setting:

Systematic review and meta-analysis according to prospectively published methodology.

Population and methods:

All studies reporting outcomes after an OASI and subsequent birth by any mode.

Main outcome measures:

AI measurement after OASI and subsequent birth. Total AI, new/worsening AI, quality of life, satisfaction, regret.

Results:

86 of 2472 screened studies met inclusion criteria. All studies contributing to meta-analyses were at high risk of bias.

There was no evidence of difference in new or worsening AI after subsequent vaginal birth (VB) compared to subsequent CS after OASI across all time periods (p=0.53: CI 0.72-1.19; 9 studies, 2104 participants); [?]2y (p=0.83: CI 0.65-1.72; 7 studies, 569 participants) or [?]5y after subsequent birth (p=0.39: CI 0.65-1.18; 2

studies; 1535 participants). There was no difference between subsequent CS or VB in asymptomatic women or for other AI or QOL outcomes. There was no evidence of difference in AI in women who subsequently delivered vs those who did not (p=0.9: CI 0.71-1.34; 10 studies, 970 participants); or pre- subsequent birth vs post-subsequent birth (p=0.31; CI 0.51-1.25, 13 studies, 5496 participants).

Conclusions:

Due to evidence quality (majority non-randomised studies) we are unable to determine whether planned cesarean is protective against AI after OASI. Higher quality data is required to guide practice in this area, specifically in asymptomatic women and for long-term outcomes.

Funding:

This study was not externally funded.

Keywords:

Obstetric Anal Sphincter Injury, OASI, OASIS, Anal Incontinence, Mode of Birth, Shared Decision Making, Cesarean, Vaginal Birth, Planned Birth, Quality of Life, Recurrent OASI

Introduction

Obstetric Anal Sphincter Injury (OASI) is the commonest cause of anal incontinence (AI) affecting young women. The incidence of OASI in primiparous women tripled to 5.9% in the UK between 2000-2012 (1) equating to 3,500 women in the UK annually. AI is defined as the involuntary loss of solid or liquid stool and or flatus. Women with OASI are between two to three times more likely to develop AI than women having an uncomplicated vaginal birth (2). Specific risk factors for AI include parity, degree of OASI and age (as risk of AI increases over a woman's lifetime) (3). Women who have recurrent OASI and fourth degree tears are particularly affected by more frequent and severe long-term symptoms of AI (4, 5). At least 10% of women who are initially asymptomatic after OASI become symptomatic by three years (6).

The presence of AI is the most important determiner of women's quality of life (QOL) after OASI (7). The 'OASIS syndrome' has been described in a study of women with AI after OASI. Feelings include being unclean, isolation, grief, anxiety, a feeling of mutilation, loss of dignity, guilt and a negative effect on motherhood, sexual intimacy and partner relations (8). Women with OASI have worse longer-term quality of life outcomes than women without OASI; this significantly correlates with symptoms of AI and number of OASI births (9). All symptoms of AI can be profoundly upsetting to women; Jango et al demonstrated a Wexner score [?]2 sufficient to affect quality of life in the long-term after OASI (10).

In women who deliver again after OASI, incidence of AI is particularly high; 48% by 2-5 years in one study (11). The long-term incidence of AI was 58.8% after a fourth-degree tear and 41.0% after a third-degree tear at a median of 8.5 years after a second birth in a population-based study (12). Additional risk factors in these women include pre-existing symptoms of AI, either 'transient AI' (13) or 'permanent AI' (2) after index birth. AI is therefore of vital consideration for all women choosing their mode of birth in subsequent pregnancies after OASI. Based on expert opinion, the Royal College of Obstetricians and Gynaecologists (RCOG) recommends medical discussion regarding birth options for symptomatic women or those with abnormal endoanal ultrasonography and/or manometry. The American College of Obstetricians and Gynaecologists (ACOG) recommend offering a cesarean section (CS) to women experiencing either AI or perineal breakdown after birth.

Birth choice is personal and can be emotive. There is a wide variation in practice between units including access to specialist perineal clinics and use and interpretation of anorectal investigations including endoanal ultrasound (EAUS) and anorectal manometry (ARMS). A 2014 survey of UK women demonstrated that only one third had access to a perineal clinic, and less than one fifth had access to endoanal ultrasound after OASI (14). Protocols outlining interpretation of anorectal investigations to directivity counsel women on planned mode of birth (MOB) after OASI differ between units (11, 15, 16, 17, 18, 19). Evidence suggests

that the majority of women in the UK are counselled regarding subsequent MOB based on their symptoms and preferences alone (14).

This study aims to systematically review and meta-analyse current evidence to determine whether CS is protective against the development of AI after OASI.

Method

Systematic review and meta-analysis were performed according to our prospectively published protocol (PROSPERO CRD42022372442) using PRISMA guidelines (20). Authors were contacted to provide data in a suitable format for meta-analysis if not supplied. Core outcome sets for OASI have not been published, but there are published protocols in development seeking to establish this for OASI (21), perineal trauma (22) and the effects of episiotomy and OASI (23). Patients and the public were not directly involved in conducting this review.

Eligibility criteria

Participants/Population:

All women >18y who have had an OASI and a subsequent birth by any mode. OASI is defined as a 3rd or 4th degree tear by the Sultan classification (24). Inclusion and exclusion criteria are described (S2).

Intervention:

Planned elective CS in a subsequent birth after an OASI, analysed by intention-to treat. Observational studies comparing vaginal birth to all CS (emergency and elective) included with risk of bias assessment.

Comparison:

Planned vaginal birth. Emergency CS was analysed with vaginal birth outcomes via intention-to-treat when possible. When data were not provided (i.e. when emergency CS was included with planned CS) the study is included with risk of bias assessed.

Outcomes:

Our primary outcome is AI (solid, liquid, flatus) after subsequent birth by any mode; including but not limited to; St Marks Score, Wexner score, EPAQ, clinical description. AI outcome is stratified by time if available: [?]2y and [?]5y.

Subgroup analysis for patients asymptomatic after index birth.

Our secondary outcomes are: QOL, regret with MOB choice, satisfaction with MOB choice, fecal urgency, obstructive defecation, change in AI pre- and post- subsequent birth, AI in women after subsequent birth vs no subsequent birth, repeat OASI rate and adverse events (return to theatre, organ injury).

Measures of effect

Dichotomous outcomes are presented as risk ratio/odds ratios with 95% CI. Continuous outcomes presented as mean difference with 95% CI.

Search strategy

MeSH subject heading and database-specific truncated search terms were used to avoid excluding potential studies. Three concepts were implemented for the search strategy: (1) identification of all types of anal sphincter or anal canal injury, (2) identification of all subsequent birth by any mode and (3) identification of all types of anal incontinence. The search terms and strategy are detailed (S1).

Information sources

Search strategy was executed in Ovid MEDLINE/PubMed 1946-2022 (Ovid), Embase 1974-2022 (Ovid), CINAHL(EBSCOhost) 1937-2022, Cochrane Combined 1996-2022, Clinical trials and Google Scholar from inception to 1st December 2022.

Study selection

Setting

We included randomised-controlled trials and non-randomised studies including observational, cohort, cross-sectional, case-control and retrospective reviews in any publication format which provided data for our outcomes of interest for a birth after OASI (Table S1).

Data extraction (selection and coding)

All title and abstract screening (EC, RH), full text review (EC, RH), data extraction (EC, KA, RH) and risk of bias assessments (EC, RH), were completed by two blinded independent reviewers according to standard Cochrane methodology. Screening took place using Rayyan review software (25). Discrepancies were resolved by a third reviewer (RK). We describe characteristics of included studies in Table S1.

Risk of bias assessment

Risk of bias was undertaken using the ROBINS-I tool (26).

Strategy for data synthesis

Dichotomous outcomes were meta-analysed in RevMan 5.4 and are presented as risk ratio/odds ratios with 95% confidence intervals. Continuous outcomes are presented as mean difference with 95% confidence intervals. When significant statistical heterogeneity was demonstrated on meta-analysis (including but not limited to I^2>40%) random effects modelling is used for meta-analyses. Studies providing data on incidence of AI are included in the 'total AI' meta-analysis, whilst studies demonstrating a change in AI score or the development of new AI symptoms in previously asymptomatic women after a subsequent birth after OASI are included in the 'new or worsening AI' meta-analysis.

Subgroup analysis

Women who were symptomatic of anal incontinence after the first birth vs those who were asymptomatic.

Results

2472 studies were identified. 86 studies met inclusion criteria after full text review (PRISMA diagram S3).

Characteristics of included studies:

Studies varied in quality and methodology. One RCT and non-randomised studies including retrospective reviews, case-control, service evaluations and questionnaire studies were included (Table S1).

For measurement of our primary outcome, eight studies used a validated questionnaire (7, 12, 17, 18, 27, 28, 29, 30) and four studies did not use a validated method of symptom assessment, relying on description alone (18, 31, 32, 33). It was possible to analyse data for an asymptomatic group of women after index OASI for two studies (Figure 3D) (27, 28).

Risk of bias:

All ten studies contributing data to meta-analysis for the primary outcome were at high risk of bias for at least one domain (Figure 1). One multicentre RCT contributed data to the analysis; however only 14.7% of 222 women randomised had a third-degree tear at the time of the index birth and the other 85.3% women were recruited after a forceps birth and had an anal sphincter defect identified on endoanal ultrasound, which was considered a surrogate marker for OASI. 71% women randomised in this study had an intact perineum at index birth (28). One prospective cohort study to 6 months follow up was included (7). Other studies were confounded by inclusion of women symptomatic of AI or were biased by retrospective reporting of outcomes after treatment allocation, failure to account for important factors such as parity or to analyse by the intention-to-treat approach, (e.g. by excluding emergency cesareans, or including elective and emergency cesarean data together). Studies were also biased by retrospective recall of AI symptoms from patients, different populations included (e.g. patients with OASI diagnosed sonographically, exclusion of women with OASI recurrence, sphincter injury not classified by Sultan criteria), use of non-validated symptom assessment tools (e.g. patient description), selective outcome reporting, use of multiple analyses, use of counselling pathways advising CS for different groups, (e.g. patients with symptoms, 4^{th} degree tear or EAUS defects), and methodological limitations (e.g. retrospective service evaluation, follow-up questionnaire with limited response rate).

Data heterogeneity:

A wide range of methods and protocols for counselling mode of subsequent birth were described based on patient symptoms alone, endoanal ultrasound, anorectal manometry, and findings on 3D transperineal ultrasound. Seven studies used EAUS to counsel women regarding mode of subsequent birth (18, 28, 29, 32, 33, 34, 35) and four used ARMS (18, 29, 32, 33) (S4). One study used 3D-TPUS but did not contribute data to meta-analysis (11).

Recurrence of OASI

49 studies reported recurrence of OASI in women undergoing subsequent vaginal birth (S5). These included 10 national or state database studies (4, 12, 36, 37, 38, 39, 40, 41, 42, 43, 44), 3 US state databases (36, 38, 40) and 1 Canadian state database (44). Three studies were multicentre studies (27, 28, 45) and 32 studies were single centre studies (11, 17, 29, 30, 31, 32, 33, 34, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69). 29 studies took place in a university or teaching hospital setting, (11, 17, 27, 28, 30, 32, 33, 34, 45, 46, 47, 49, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 65, 67, 68, 69) and six were in a district general hospital setting (29, 31, 48, 50, 64, 66).

The mean index OASI rate was 3.31% and mean recurrence rate was 6.6% across all studies (7413 cases: range 1.9-25%, S5). Index OASI rates were higher in teaching hospitals (6.13% n=32) compared to population-based studies (4.34% n=11) and district general hospitals (3.2% n=6). Recurrent OASI rates were higher in district general hospitals (11.74% range 6.6-25% n=6) but similar in teaching hospitals (6.02% range 1.9%-13.4% n=32) and population-based studies (5.59% range 2.1-7.2% n=11). A summary of rOASI rates provided by population-based studies (Figure 2) and all studies (S5) is described.

Incidence of AI after subsequent vaginal birth (VB) and subsequent CS after OASI

The incidence of AI after a subsequent birth after OASI was reported by twenty-two studies. 12 studies (one RCT and 11 non-randomised studies) were suitable for meta-analysis as they included data for both CS and VB in a suitable form for pooling, and their characteristics are described (S4, Table S1) (7, 12, 18, 27, 28, 29, 31, 32, 33, 34). Some participants from one study (70) were included in a later publication (29) therefore we excluded the earlier study from meta-analyses. Two studies described satisfaction with MOB choice (17, 34), two studies described regret with MOB choice (27, 30) and two studies described quality of life after subsequent birth (7, 12). 11 studies were not suitable for meta-analysis (11, 13, 17, 46, 65, 67, 69, 71, 72, 73, 74) as they either did not contain a comparison group or did not contribute data in an interpretable format (and either were not able to provide this or did not respond on contact with the corresponding author).

There was no evidence of a difference in deterioration in AI (new or worsening symptoms) after subsequent VB compared to CS after OASI across all follow up time periods studied (Figure 3A: p=0.74; CI 0.72-1.19, 9 studies- 1 RCT 8 non-RCT, 2104 participants). There was no evidence of a difference for short-term symptoms at 3-24 months (Figure 3B: p=0.71; CI 0.65-1.72, 7 studies, 569 participants) or long-term symptoms at [?]5 years (Figure 3C: p=0.39; CI 0.65-1.18, 2 studies, 1536 participants) between groups. There was no evidence of a difference in AI between VB and CS in studies who recruited only asymptomatic women (Figure 3D: p=0.43; CI 0.71-2.20, 2 studies, 220 participants).

The total incidence of AI after subsequent birth after OASI may be higher after CS than VB; the wide CI is consistent with little effect or harm (Figure 4: p=0.03; 95% CI 1.08-3.47; 6 studies, 2253 participants). These studies include women who were symptomatic pre-subsequent birth. Symptomatic women were more likely to have subsequent CS than VB across the studies. The presence of pre-existing AI symptoms is therefore a significant confounder.

The incidence of incontinence of solid or liquid stool, flatal incontinence and fecal urgency does not differ between women who have a subsequent CS vs VB (S6). There is no evidence of a difference in levels of satisfaction (17, 34) and regret (27, 30) (S7); regret is inversely proportional to satisfaction (30). There was no evidence of a difference in QOL overall (S7); one study demonstrated higher levels of 'incontinence impact' and 'physical limitations' in women having CS vs VB (7). Reduction in QOL is directly proportional to patient symptoms of AI after OASI (70).

In a study not suitable for meta-analysis, patients subsequently delivering by CS had a significantly lower Vaiezy score compared with subsequent VB, and those following MOB recommendations also demonstrated significantly less AI (65). Another study demonstrated higher Wexner scores overall in women delivering by CS vs VB, however there was no difference in average pre- and post- birth scores in the CS and VB groups (17). These studies demonstrate the difficulties with interpreting results from individual sites, the confounder of a higher symptomatic population in the CS group and widespread practice variation.

Other outcomes

No studies reported on symptoms of irritable bowel syndrome, obstructive defecation, blood loss or length of stay.

Anal incontinence and subsequent birth by any mode

Twelve studies have investigated whether there is a difference in AI in women who have a subsequent birth compared to women who have not had a subsequent birth after OASI. Ten studies were suitable for meta-analysis (S8A) (13, 31, 55, 73, 75, 76, 77, 78, 79, 80). There is no evidence of a difference in AI in women who have a subsequent birth by any mode vs those who have not (S8A: p=0.9; CI 0.71-1.34, 10 studies 970 participants). One study looked at QOL with a subsequent birth vs no subsequent birth (S8B). There was no difference in QOL outcomes for women with a subsequent birth by any mode compared to those who did not (55). A previous review meta-analysed this outcome in 2016 (35). Only one further study has been added since this time (7).

Anal incontinence pre- and post- subsequent birth

The incidence of AI in the same patients pre- and post- subsequent birth by any mode does not differ between a mixed symptomatic and asymptomatic patient group across all time periods studied (S9: p=0.31; CI 0.51-1.25, 13 studies, 5496 participants) (7, 12, 13, 18, 31, 32, 33, 34, 70, 74, 76, 81, 82).

Discussion

Main findings

Preventative value of CS for AI after OASI

This analysis does not demonstrate a protective benefit for routine elective CS in preventing new or worsening symptoms of AI after OASI in a group of women who are both symptomatic and asymptomatic after their index OASI. This was analysed from either a deterioration on a validated scoring system or a description of new or worsening symptoms in women by study authors after a subsequent birth after OASI. There is no evidence of difference in deterioration of AI between women who deliver by CS compared to women who deliver by VB after OASI overall, in the shorter-term or longer-term (Figure 3A-C). For two studies in which an asymptomatic group was analysed, there was also no evidence of a difference in AI symptoms in the short-term; however there are significant limitations to both studies (Figure 3D).

Regarding the certainty of the results, all included studies were at high risk of bias for at least one outcome (Figure 1). This was due to: limitations with the population recruited; non-randomisation to treatment outcomes; inclusion of symptomatic women causing systemic bias; retrospective analysis; failure to analyse by intention-to-treat (emergency CS group included with elective CS group or excluded) and a lack of validated outcome data measurement (Figure 2). We do not have data to counsel specific groups; i.e. symptomatic women, asymptomatic women, women with recurrent OASI.

Long term data

In the longer term, there is evidence from a larger population-based study that women subsequently delivering by VB after OASI may experience worsening of AI symptoms 5-12y after subsequent birth compared to CS; however, this was not significant on the author's multivariate analysis (12). The study relied on retrospective recall of patient symptoms after index birth. EAUS and ARMS were not used to routinely counsel women regarding subsequent birth; it was national practice for symptomatic women to undergo CS and asymptomatic women to undergo subsequent VB.

The other study providing long-term data outcomes compared two different control groups of 50 patients however this study was not powered to investigate long term AI symptoms between these groups (27). Therefore, both studies in our meta-analysis have significant limitations and we need higher quality data to investigate differences in long-term AI symptoms in asymptomatic women after OASI who deliver by VB or CS.

Recurrence of OASI

Women who sustain an OASI recurrence have poorer long term incontinence outcomes than women who deliver without an OASI (5); studies included in this review did not provide data for this specific outcome. Rates of index OASI are higher in teaching and university hospitals compared to population-based studies and district-general hospitals (DGHs). However, rates of recurrent OASI are highest in DGHs. There is an extremely wide variation in OASI recurrence rates reported across studies, representing a 25-fold difference. This may relate to training in OASI detection and participation in research in some units, differences in

OASI detection rates and classification over time, regional differences in obstetric practice and care to avoid recurrence e.g. by using OASI care bundles in some units.

Strengths and limitations

This comprehensive review summarises the current evidence for whether elective cesarean section is protective against the development of AI after OASI. It uses a robust prospectively published systematic methodology to double-extract data and appraise the risk of bias of this data by two independent study authors. This is an extremely important area clinically as AI has a profound negative effect on the lives of young women, OASI is common, and AI is very common after OASI. This area is under-researched; current guidelines utilise level 4 evidence and there is consequently widespread variation in clinical practice.

This study meta-analyses both (1) the total incidence of AI after subsequent VB compared to subsequent CS after OASI and (2) the presence of new or worsening AI after subsequent VB compared to subsequent CS after OASI. To our knowledge, it is the first study to investigate both outcomes. It highlights challenges appraising evidence from non-randomised mode of birth studies due to significant confounding caused by including women with pre-existing symptoms of AI. It is therefore difficult to provide clinically interpretable information on the preventative value of CS against worsening AI from existing published data.

Asymptomatic vs symptomatic women

This review is limited by the methodology of the published data, particularly the ability to extract values for just women who are symptomatic or asymptomatic after index OASI. When counselling women clinically, this is an important factor. Most studies are service evaluations which include both symptomatic and asymptomatic women as one group. Additionally, most published data do not used a validated incontinence score to pair data pre- and post- birth after OASI therefore it is difficult to extract data for women who have 'new' or 'worse' AI after birth.

Quality of the data

The vast majority of included studies were at high risk of bias for at least one outcome. This was due to: limitations with the population recruited; non-randomisation to treatment outcomes; inclusion of symptomatic women causing systemic bias; retrospective analysis; failure to analyse by intention-to-treat (emergency cesarean group included with elective cesarean group or excluded); and a lack of validated outcome data assessment (Figure 1). All studies except two included women with pre-existing AI symptoms.

Data heterogeneity

One difference between studies is the use of EAUS, ARMS and 3D-TPUS to assess anal sphincter defects and counsel women alongside symptoms to undergo planned VB or planned CS after OASI (Table S1, S4). Defects on EAUS are significantly correlated with symptoms of AI both in women with a history of OASI diagnosed at birth (55% have a persistent sphincter defect and 38% have AI) and in those without (13% have sphincter defects and 14% have AI) (83). We include all women in these meta-analyses however it would be valuable to appreciate the role of EAUS, ARMs and 3D-TPUS in the long term in guiding practice, specifically whether CS is valuable in preventing AI in asymptomatic women with defects/abnormal physiology who undergo subsequent birth.

Deviations from study protocol

Although our protocol aim was to stratify AI by follow up time period (short-term ([?]1y), medium-term (>1y <5y), long-term ([?]5y)) this was not due to the ranges in follow-up time period employed by particular studies (S4) (12, 31, 33, 34). Instead, we meta-analyses two time periods; 3-24 months (short term) and [?]5y (long term).

Interpretation of results

This systematic review has not demonstrated a protective effect of CS over VB to prevent new or worsening AI symptoms after OASI in the short-term. Data presented in this meta-analysis represents a mixed group of symptomatic and asymptomatic women and nearly all studies were at high risk of bias and short follow up duration. It therefore does not reliably assess an effect of subsequent MOB on long-term AI outcomes, or provide individualised risk assessment for groups of women who are symptomatic or asymptomatic after OASI.

Evidence to support counselling women after OASI is limited. There is a paucity of data on long-term outcomes and knowledge about women's preferences and decision-making (84). Factors predicting worse AI with subsequent birth after OASI include transient or ongoing AI symptoms after index birth (13), fourth-degree tear (5, 24) and recurrent OASI (4). Factors predicting better AI outcomes with subsequent birth after OASI include absence of AI after index birth (13), normal anorectal physiology (29), lesser degree of injury (24) and absence of injury at subsequent birth (4).

Practical and research recommendations

The evidence included in this review is limited and comes mostly from service evaluations undertaken on mixed groups of women (17, 18, 19, 29, 31, 32, 70, 82). Higher-quality evidence is required to enable clinicians to personalise the risk of future AI based on index birth factors, maternal risk and current pregnancy details in women who deliver after OASI. This should differentiate the risk for asymptomatic and symptomatic women. Research to ascertain the value of anorectal physiology investigations in predicting longer term AI outcomes would be beneficial and enable standardisation of antenatal counselling pathways.

Conclusion

This systematic review and meta-analysis summarises the results of 84 studies investigating outcomes in women who subsequently deliver after OASI. Evidence is of low quality and does not support the routine practice of elective cesarean to prevent new or worsening AI symptoms in a mixed symptomatic and asymptomatic group of women. There are significant limitations to existing published data, specifically relating to counselling of asymptomatic women and regarding long-term AI outcomes. Further research is required so that women can be provided with personalised risk indicators for AI for birth after OASI.

Disclosure of interests

The authors have no relevant financial, personal, political, intellectual or religious conflicts of interest to declare.

Contribution to Authorship

EC: Project design and conception. Prospectively registered and independently performed aspects of the systematic review and meta-analysis including title/abstract screening, data extraction, data analysis, risk of bias assessments, statistical analysis, interpretation of results and project writeup.

RH: Performed independent title/abstract screening, independent double data extraction for the recurrence of OASI data and independent risk of bias assessments.

KA: Performed independent double data extraction for the included studies.

JM: Contributed substantially to writeup and clinical interpretation of results.

RK: Instrumental in project design and conception. Performed data analysis and substantially contributed to project writeup and interpretation of results.

Details of Ethical approval

Ethical approval was not required for this study. The primary review author has completed review author training in systematic review with Cochrane.

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References

1. Gurol-Urganci I, Cromwell DA, Edozien LC, Mahmood TA, Adams EJ, Richmond DH, et al. Third- and fourth-degree perineal tears among primiparous women in England between 2000 and 2012: time trends and risk factors. BJOG. 2013;120(12):1516-25.

2. LaCross A, Groff M, Smaldone A. Obstetric anal sphincter injury and anal incontinence following vaginal birth: a systematic review and meta-analysis. J Midwifery Womens Health. 2015;60(1):37-47.

3. Fornell EU, Matthiesen L, Sjodahl R, Berg G. Obstetric anal sphincter injury ten years after: subjective and objective long term effects. BJOG. 2005;112(3):312-6.

4. Jango H, Langhoff-Roos J, Rosthoj S, Sakse A. Recurrent obstetric anal sphincter injury and the risk of long-term anal incontinence. Am J Obstet Gynecol. 2017;216(6):610 e1- e8.

5. Jango H, Langhoff-Roos J, Rosthoj S, Saske A. Long-term anal incontinence after obstetric anal sphincter injury-does grade of tear matter? Am J Obstet Gynecol. 2018;218(2):232 e1- e10.

6. Reid AJ, Beggs AD, Sultan AH, Roos AM, Thakar R. Outcome of repair of obstetric anal sphincter injuries after three years. Int J Gynaecol Obstet. 2014;127(1):47-50.

7. Webb SS, Sitch A, MacArthur C. The impact of mode of subsequent birth after obstetric anal sphincter injury on bowel function and related quality of life: a cohort study. Int Urogynecol J. 2020;31(11):2237-45.

8. Keighley MR, Perston Y, Bradshaw E, Hayes J, Keighley DM, Webb S. The social, psychological, emotional morbidity and adjustment techniques for women with anal incontinence following Obstetric Anal Sphincter Injury: use of a word picture to identify a hidden syndrome. BMC Pregnancy Childbirth. 2016;16(1):275.

9. Nilsson IEK, Akervall S, Molin M, Milsom I, Gyhagen M. Severity and impact of accidental bowel leakage two decades after no, one, or two sphincter injuries. Am J Obstet Gynecol. 2023;228(4):447 e1- e19.

10. Jango H, Langhoff-Roos J, Rosthoj S, Sakse A. Wexner score and quality of life in women with obstetric anal sphincter injury. Int Urogynecol J. 2020;31(6):1115-21.

11. van der Vlist M, Oom D, van Rosmalen J, van Ovost A, Hogewoning C. Parturition mode recommendation and symptoms of pelvic floor disorders after obstetric anal sphincter injuries. Int Urogynecol J. 2020;31(11):2353-9.

12. Jango H, Langhoff-Roos J, Rosthoj S, Sakse A. Mode of delivery after obstetric anal sphincter injury and the risk of long-term anal incontinence. Am J Obstet Gynecol. 2016;214(6):733 e1- e13.

13. Bek KM, Laurberg S. Risks of anal incontinence from subsequent vaginal delivery after a complete obstetric anal sphincter tear. Br J Obstet Gynaecol. 1992;99(9):724-6.

14. Ismail SI. A national questionnaire survey of consultants and middle grade doctors' perception of foundation doctors in obstetrics and gynaecology in the United Kingdom. Arch Gynecol Obstet. 2014;290(6):1159-67.

15. Badri H, Fowler G, Lane S. The role of anal manometry in the follow-up of women with obstetric anal sphincter injuries (OASI). Int Urogynecol J. 2023;34(2):399-404.

16. Cassis C, Giarenis I, Mukhopadhyay S, Morris E. Mode of delivery following an OASIS and caesarean section rates. Eur J Obstet Gynecol Reprod Biol. 2018;230:28-31.

17. Fitzpatrick M, Cassidy M, Barassaud ML, Hehir MP, Hanly AM, O'Connell PR, et al. Does anal sphincter injury preclude subsequent vaginal delivery? Eur J Obstet Gynecol Reprod Biol. 2016;198:30-4.

18. Karmarkar R, Bhide A, Digesu A, Khullar V, Fernando R. Mode of delivery after obstetric anal sphincter injury. Eur J Obstet Gynecol Reprod Biol. 2015;194:7-10.

19. Okeahialam NA, Thakar R, Sultan AH. Effect of a subsequent pregnancy on anal sphincter integrity and function after obstetric anal sphincter injury (OASI). Int Urogynecol J. 2021;32(7):1719-26.

20. Carter E KR, Hall R. Is Caesarean Section for Subsequent Delivery Protective Against Fecal Incontinence in Women with Obstetric Anal Sphincter Injury (OASI)? A systematic review and meta-analysis protocol [Systematic review registration]. 2022 [updated 2022.

21. Daly O, Mol B, Rogers R, Sultan A, Thakar R, Webb R, et al. The CO-OPT Study: Core Outcomes in Obstetric Anal Sphincter Injury Prevention and Treatment COMET website2017 [Available from: https://www.comet-initiative.org/studies/details/959.

22. Doumouchtsis SK, Rada MP, Pergialiotis V, Falconi G, Haddad JM, Betschart C. A protocol for developing, disseminating, and implementing a core outcome set (COS) for childbirth pelvic floor trauma research. BMC Pregnancy Childbirth. 2020;20(1):376.

23. Gachon B, Schmitz T, Artzner F, Parant O, De Tayrac R, Ducarme G, et al. A core outcome set development for a French national prospective study about the effect of mediolateral episiotomy on obstetric anal sphincter injury during operative vaginal delivery (INSTRUMODA). BMC Pregnancy Childbirth. 2021;21(1):251.

24. Okeahialam NA, Taithongchai A, Thakar R, Sultan AH. The incidence of anal incontinence following obstetric anal sphincter injury graded using the Sultan classification: a network meta-analysis. Am J Obstet Gynecol. 2023;228(6):675-88 e13.

25. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. Syst Rev. 2016;5(1):210.

26. Sterne JA, Hernan MA, Reeves BC, Savovic J, Berkman ND, Viswanathan M, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. BMJ. 2016;355:i4919.

27. Bogeskov RA, Nickelsen CN, Secher NJ. Anal incontinence in women with recurrent obstetric anal sphincter rupture: a case control study. J Matern Fetal Neonatal Med. 2015;28(3):288-92.

28. Abramowitz L, Mandelbrot L, Bourgeois Moine A, Tohic AL, Carne Carnavalet C, Poujade O, et al. Caesarean section in the second delivery to prevent anal incontinence after asymptomatic obstetric anal sphincter injury: the EPIC multicentre randomised trial. BJOG. 2021;128(4):685-93.

29. Jordan PA, Naidu M, Thakar R, Sultan AH. Effect of subsequent vaginal delivery on bowel symptoms and anorectal function in women who sustained a previous obstetric anal sphincter injury. Int Urogynecol J. 2018;29(11):1579-88.

30. Edwards M, Kobernik EK, Suresh S, Swenson CW. Do women with prior obstetrical anal sphincter injury regret having a subsequent vaginal delivery? BMC Pregnancy Childbirth. 2019;19(1):225.

31. Dilmaghani-Tabriz D, Soliman N. Delivery after third- or fourth- degree perineal tear. BJOG An International Journal of Obstetrics and Gynaecology. 2012;119:42.

32. Harkin R, Fitzpatrick M, O'Connell PR, O'Herlihy C. Anal sphincter disruption at vaginal delivery: is recurrence predictable? Eur J Obstet Gynecol Reprod Biol. 2003;109(2):149-52.

33. Tetzschner T, Sorensen M, Lose G, Christiansen J. Anal and urinary incontinence in women with obstetric anal sphincter rupture. Br J Obstet Gynaecol. 1996;103(10):1034-40.

34. Young R, Bates L, The S, King J. Mode of delivery following obstetric anal sphincter injury: a 7-year retrospective review and follow-up cohort survey. Int Urogynecol J. 2022;33(12):3365-9.

35. Webb SS, Yates D, Manresa M, Parsons M, MacArthur C, Ismail KM. Impact of subsequent birth and delivery mode for women with previous OASIS: systematic review and meta-analysis. Int Urogynecol J. 2017;28(4):507-14.

36. Ampt AJ, Roberts CL, Morris JM, Ford JB. The impact of first birth obstetric anal sphincter injury on the subsequent birth: a population-based linkage study. BMC Pregnancy Childbirth. 2015;15:31.

37. Baghestan E, Irgens LM, Bordahl PE, Rasmussen S. Risk of recurrence and subsequent delivery after obstetric anal sphincter injuries. BJOG. 2012;119(1):62-9.

38. Dandolu V, Gaughan JP, Chatwani AJ, Harmanli O, Mabine B, Hernandez E. Risk of recurrence of anal sphincter lacerations. Obstet Gynecol. 2005;105(4):831-5.

39. Edozien LC, Gurol-Urganci I, Cromwell DA, Adams EJ, Richmond DH, Mahmood TA, et al. Impact of third- and fourth-degree perineal tears at first birth on subsequent pregnancy outcomes: a cohort study. BJOG. 2014;121(13):1695-703.

40. Parmar S, Towner D, Xing G, Wallach S. Recurrent anal sphincter injury: a population based study. American Journal of Obstetrics and Gynaecology. 2012;206(1):S150.

41. Pirhonen J, Haadem K, Gissler M. Delivery after an obstetric anal sphincter tear. Arch Gynecol Obstet. 2020;301(6):1479-84.

42. Spydslaug A, Trogstad LI, Skrondal A, Eskild A. Recurrent risk of anal sphincter laceration among women with vaginal deliveries. Obstet Gynecol. 2005;105(2):307-13.

43. van Bavel J, Hukkelhoven C, de Vries C, Papatsonis DNM, de Vogel J, Roovers JWR, et al. The effectiveness of mediolateral episiotomy in preventing obstetric anal sphincter injuries during operative vaginal delivery: a ten-year analysis of a national registry. Int Urogynecol J. 2018;29(3):407-13.

44. Boggs EW, Berger H, Urquia M, McDermott CD. Recurrence of obstetric third-degree and fourth-degree anal sphincter injuries. Obstet Gynecol. 2014;124(6):1128-34.

45. D'Souza JC, Monga A, Tincello DG, Sultan AH, Thakar R, Hillard TC, et al. Maternal outcomes in subsequent delivery after previous obstetric anal sphincter injury (OASI): a multi-centre retrospective cohort study. Int Urogynecol J. 2020;31(3):627-33.

46. Ali A, Glennon K, Kirkham C, Yousif S, Eogan M. Delivery outcomes and events in subsequent pregnancies after previous anal sphincter injury. Eur J Obstet Gynecol Reprod Biol. 2014;174:51-3.

47. An V, D'Souza B, Thomas E, Schierlitz L, Woods R, Keck J. Obstetric Anal Sphincter Injuries; Outcome and Function after Subsequent Deliveries. Colorectal Disease. 2014;16(0):89.

48. Antonakou A, Papoutsis D, Henderson K, Qadri Z, Tapp A. The incidence of and risk factors for a repeat obstetric anal sphincter injury (OASIS) in the vaginal birth subsequent to a first episode of OASIS:

a hospital-based cohort study. Arch Gynecol Obstet. 2017;295(5):1201-9.

49. Basham E, Stock L, Lewicky-Gaupp C, Mitchell C, Gossett DR. Subsequent Pregnancy Outcomes After Obstetric Anal Sphincter Injuries. Obstetrical and Gynaecological Survey. 2014;69(2):78-9.

50. Bayar E, Mukri F, Ramalingam K. A clinical audit; Risk of subsequent perineal trauma after previous obstetric anal sphincter injury. Archives of Disease in Childhood: Fetal and Neonatal Edition. 2013;98(0).

51. Dakin A, Eogan M. Birth preferences and delivery outcomes after previous obstetric anal sphincter injury. Eur J Obstet Gynecol Reprod Biol. 2021;266:125.

52. Daly J, Sultan AH, Van delft KW, Thakar R. Outcome of childbirth after previous obstetric anal sphincter injury. International Urogynecology Journal and Pelvic Floor Dysfunction 2013;24(0):S69-70.

53. Davies D, Bahl R. Recurrence rate of third degree perineal tears at St Michael's Hospital. Archives of Disease in Childhood: Fetal and Neonatal Edition. 2013;98(0).

54. Doumouchtsis SK, Anparasan A, Chis-Ster I, Abbas N, Gauthaman N. Recurrent obstetric anal sphincter injuries (OASIS): Is prediction possible? Neurourology and Urodynamics. 2014;33(6):883-4.

55. Fradet-Menard C, Deparis J, Gachon B, Sichitiu J, Pierre F, Fritel X, et al. Obstetrical anal sphincter injuries and symptoms after subsequent deliveries: A 60 patient study. Eur J Obstet Gynecol Reprod Biol. 2018;226:40-6.

56. Izett ML, Giarenis I, Thiagamoorthy G, Robinson D, Cardozo L. Obstetric anal sphincter injury (OASIS): What happens next? International Urogynecology Journal and Pelvic Floor Dysfunction. 2015;26(1):S42-3.

57. Lowder JL, Burrows LJ, Krohn MA, Weber AM. Risk factors for primary and subsequent anal sphincter lacerations: a comparison of cohorts by parity and prior mode of delivery. Am J Obstet Gynecol. 2007;196(4):344 e1-5.

58. Moffatt J, Basude S. Factors influencing mode of delivery in women with previous OASI. BJOG: An International Journal of Obstetrics and Gynaecology. 2022;129(0):56.

59. Nausheen S, Roberts AJ, Wakefield N, Canavan L, Dinardo L. Mode of delivery and perineal injury following primary obstetric anal sphincter injury. BJOG: An International Journal of Obstetrics and Gynaecology. 2014;121(0):228.

60. Nutaitis A, Kollikonda S, Yao M, Hickman L, Propst K. OBSTETRIC ANAL SPHINCTER INJURY: GUIDANCE FOR FUTURE DELIVERY ROUTE. Female Pelvic Medicine and Reconstructive Surgery. 2022;28:S11-S2.

61. Park Y, Nguyen N, Vatsayan A. Does maternal age at subsequent pregnancy, maternal weight and birth weight of baby impact on risk of subsequent severe perineal tears following third and fourth degree perineal tears in first pregnancy? BJOG: An International Journal of Obstetrics and Gynaecology. 2015;122(0):392-3.

62. Ramalingam K, Roberts A. Pregnancy outcomes after recurrent obstetric anal sphincter injuries. Female Pelvic Medicine and Reconstructive Surgery. 2014;20(0):S157-S8.

63. Rahim A, Bhide A, Mackdermott N, Tailor V, Patel M, Digesu A, et al. Mode of delivery following OASIS: A 5-year follow up study of subsequent deliveries after 3rd and 4th degree vaginal tears. Neurourology and Urodynamics. 2021;40:S42-S3.

64. Thiel M, Behrens R. Outcome of subsequent delivery in women with previous obstetric anal sphincter injury (OASIS). International Urogynecology Journal and Pelvic Floor Dysfunction. 2015;26(1):S129-30.

65. Vasseur A, Lepigeon K, Baud D, Horsch A, Meyer S, Vial Y, et al. Counseling after perineal laceration: does it improve functional outcome? Int Urogynecol J. 2019;30(6):925-31.

66. Viner A, Narrainen Poulle T. Incidence and recurrence of obstetric anal sphincter injury (OASIS). BJOG: An International Journal of Obstetrics and Gynaecology. 2017;124:11.

67. Wegnelius G, Hammarstrom M. Complete rupture of anal sphincter in primiparas: long-term effects and subsequent delivery. Acta Obstet Gynecol Scand. 2011;90(3):258-63.

68. Yogev Y, Hiersch L, Maresky L, Wasserberg N, Wiznitzer A, Melamed N. Third and fourth degree perineal tears–the risk of recurrence in subsequent pregnancy. J Matern Fetal Neonatal Med. 2014;27(2):177-81.

69. Yousif S, Eogan M. Mode of delivery after previus anal sphincter injury (ASI): Role of the perineal clinic. Irish Journal of Medical Science. 2011;180(0):S122.

70. Scheer I, Thakar R, Sultan AH. Mode of delivery after previous obstetric anal sphincter injuries (OASIS)–a reappraisal? Int Urogynecol J Pelvic Floor Dysfunct. 2009;20(9):1095-101.

71. An V, D'Souza B, Thomas E, Schierlitz L, Woods R, Keck J. Obstetric anal sphincter injuries; outcome and function after subsequent deliveries. Colorectal Disease. 2014;16:89.

72. De Leeuw JW, Vierhout ME, Struijk PC, Hop WC, Wallenburg HC. Anal sphincter damage after vaginal delivery: functional outcome and risk factors for fecal incontinence. Acta Obstet Gynecol Scand. 2001;80(9):830-4.

73. Faltin DL, Boulvain M, Stan C, Epiney M, Weil A, Irion O. Intraobserver and interobserver agreement in the diagnosis of anal sphincter tears by postpartum endosonography. Ultrasound Obstet Gynecol. 2003;21(4):375-7.

74. Younis J, Rajendran N, Walker H, Wolf G, McWilliams D, Bearn P. Deterioration of anal sphincter function following second vaginal delivery in women with previous intrapartum perineal tears. 2010;12:20.

75. Kumar R, Ooi C, Nicoll A. Anal incontinence and quality of life following obstetric anal sphincter injury. Arch Gynecol Obstet. 2012;285(3):591-7.

76. Nordenstam J, Altman D, Brismar S, Zetterstrom J. Natural progression of anal incontinence after childbirth. Int Urogynecol J Pelvic Floor Dysfunct. 2009;20(9):1029-35.

77. Poen AC, Felt-Bersma RJ, Cuesta MA, Meuwissen GM. Vaginal endosonography of the anal sphincter complex is important in the assessment of faecal incontinence and perianal sepsis. Br J Surg. 1998;85(3):359-63.

78. Sangalli MR, Floris L, Faltin D, Weil A. Anal incontinence in women with third or fourth degree perineal tears and subsequent vaginal deliveries. Aust N Z J Obstet Gynaecol. 2000;40(3):244-8.

79. Sze EH. Anal incontinence among women with one versus two complete third-degree perineal lacerations. Int J Gynaecol Obstet. 2005;90(3):213-7.

80. Sze EH. Prevalence and severity of anal incontinence in women with and without additional vaginal deliveries after a fourth-degree perineal laceration. Dis Colon Rectum. 2005;48(1):66-9.

81. Walker HJ, Gelman W, Thomas JM, Bearn PE, McWilliams D. Does vaginal delivery after Obstetric Anal Sphincter Injury (OASI) cause further damage? International Urogynecology Journal and Pelvic Floor Dysfunction. 2009;20:S278-9.

82. Bondili A, Siddiqui I, Nichols W, Kettle C, Cooper J, O'mahony F, et al. Management of pregnancies following third and fourth degree perineal tears: A multi disciplinary approach. International Urogynecology Journal and Pelvic Floor Dysfunction. 2011;22:S120-1.

83. Sideris M, McCaughey T, Hanrahan JG, Arroyo-Manzano D, Zamora J, Jha S, et al. Risk of obstetric anal sphincter injuries (OASIS) and anal incontinence: A meta-analysis. Eur J Obstet Gynecol Reprod Biol. 2020;252:303-12.

84. Narice BF, Marks K, Jha S. Factors that influence pregnant women's decision on mode of delivery after previous obstetric anal sphincter injury. Eur J Obstet Gynecol Reprod Biol. 2023;281:32-5.

Figure and table legends

Figure 1: ROBINS Risk of bias assessment tool for studies included in meta-analysis for the primary outcome

Figure 2: Index and recurrent OASI rates across included studies

Figure 3: Anal incontinence and mode subsequent birth after OASI

Figure 4: Total incidence of anal incontinence after subsequent birth

Table S1: Characteristics of included studies

S2: Study inclusion and exclusion criteria

S3: Prisma diagram

S4: Description of studies included for primary outcome

S5: Recurrent OASI rates across all studies

S6: Meta-analysis for secondary AI outcomes (1) solid (2) liquid (3) flatus (4) urgency

S7: Satisfaction, regret and QOL after subsequent birth

S8: Subsequent birth vs no subsequent birth after OASI

S9: Incidence of AI pre- and post- subsequent birth; paired data

Primary Figures

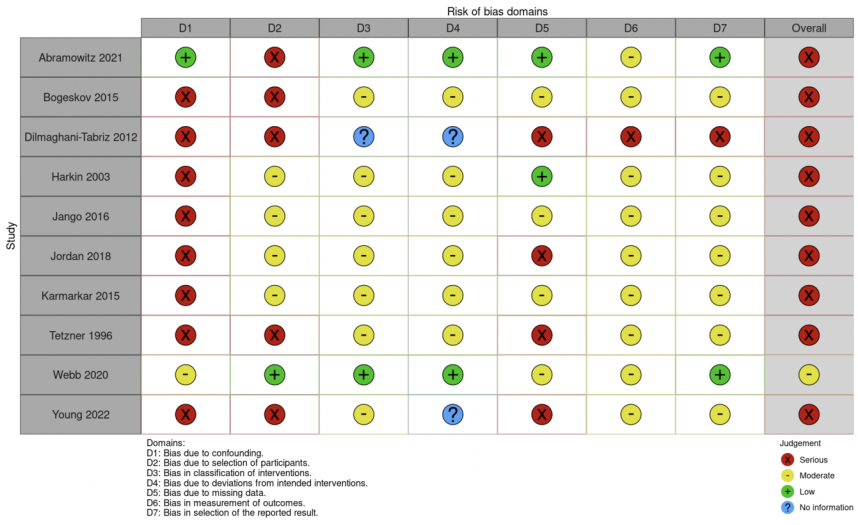


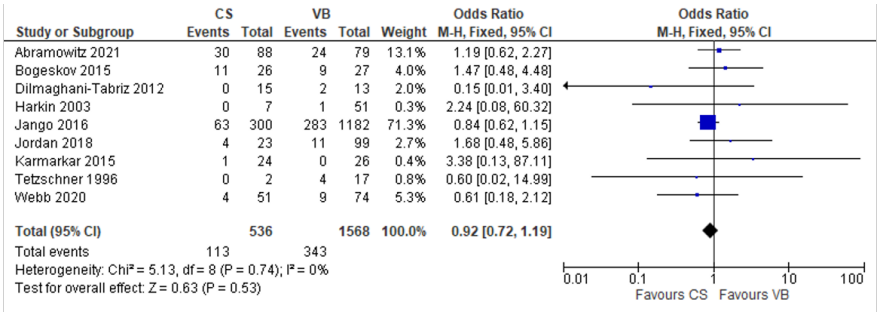
Figure 1: ROBINS Risk of bias assessment tool for studies included meta-analysis for the primary outcome

Figure 2: Index and recurrent OASI rates across included studies

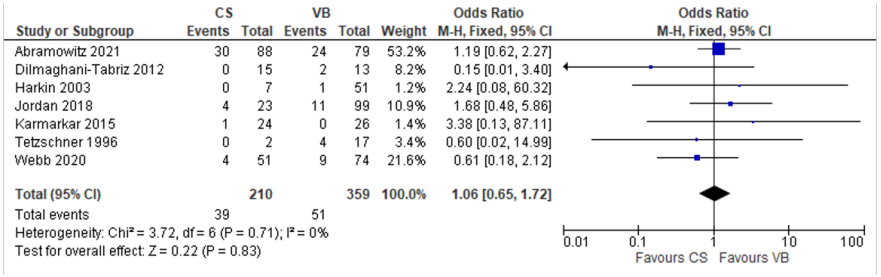
rOASI population	No studies	Index OASI rate (%)	rOASI rate (%)	rOASI range %
All studies	49	3.31	6.6	1.9-25%
National/state database	12	4.34	5.59	2.1-7.2%
Teaching/university hospital	32	6.13	6.02	1.9-13.4%
District general hospital	6	3.2	11.74	6.66-25%

Figure 3: Anal incontinence and mode subsequent birth after OASI

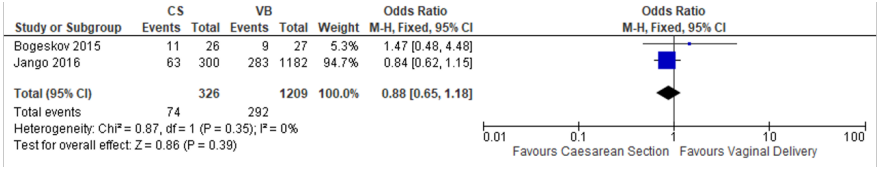
A New or worsening AI after subsequent birth- all time periods



B New or worsening AI after subsequent birth- short term (3 months-2 years)



C New or worsening AI after subsequent birth- long term ([?] 5 years)



D AI in asymptomatic women after subsequent birth, all time periods

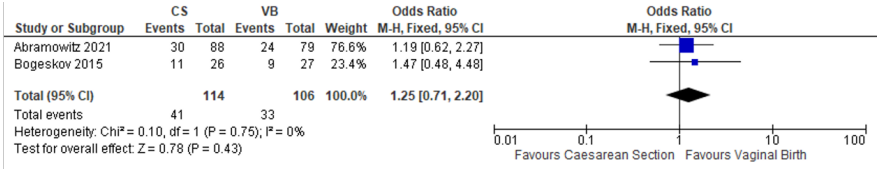


Figure 4: Total incidence of anal incontinence after subsequent birth

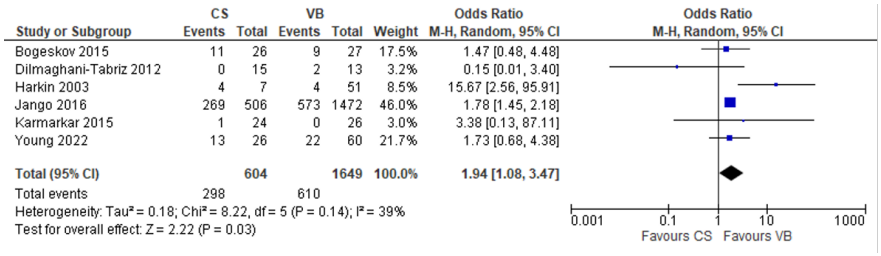


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Figure 1 ROBINS ROB summary graph.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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Figure 2 rOASI .docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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Figure 3- Incidence of AI after subsequent birth.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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Figure 4 Total incidence of AI after SB (VD&CS).docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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S2 Inclusion & Exclusion criteria.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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S3 Prisma diagram.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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S4 Description of included studies for primary outcome.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-

incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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S5 Recurrence of OASI rates, all data.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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S6 solid, liquid, flatal, fecal urgency.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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S7 satisfaction, regret and QOL.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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S8 subsequent birth vs no subsequent birth.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis

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S9 Incidence of anal incontinence pre- vs post- subsequent birth.docx available at https://authorea.com/users/698051/articles/685902-is-cesarean-section-protective-against-anal-incontinence-in-women-after-obstetric-anal-sphincter-injury-oasi-a-systematic-review-and-meta-analysis