Index Page

Name Leo

Surname Gundle

Oriel Pin 91629

Evidence uploaded	Page Numbers	NO OF PIECES OF EVIDENCE SUBMITTED	Score on the portal for the domains
Domain 1 Commitment to specialty	9 pages	5	14/14
Domain 2 Quality improvement / Clinical audit	8 pages	4	13/13
Domain 3 Presentations and Publications	16 pages	3	10/10
Domain 4 Teaching Experience / Training Qualifications	3 pages	2	13/15

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Signature- 

Date: 8th February 2023

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Date: 8th February 2023

DOMAIN 1 – Commitment to specialty

[Insert evidence-here and continue overleaf if necessary]

Domain 1 Contents

1. Letter from Educational Supervisor confirming Foundation Year Surgical Placement

2. Surgical Conference Certificates x 3

3. Validated operative eLogbook

DEPARTMENT OF DERMATOLOGY

Direct Line: 0300 019 2057

e-mail: dermatology.secretaries@uhd.nhs.uk

University Hospitals Dorset NHS

NHS Foundation Trust

Poole Hospital
Longfleet Road
Poole
Dorset
BH15 2JB

Tel. 01202 665511

www.uhd.nhs.uk

November 2022

Dear Sir/ Madam,

For the purposes of his Core Surgical Training Application, I, as his Education Supervisor, can confirm that Dr Leo Gundle undertook a placement in General Surgery at Poole Hospital during his Foundation Year 1 training.

This placement took place between 2nd December 2020 and 6th April 2021, a period of approximately 16 weeks.

Yours sincerely,

Dr Suzannah August
Consultant Dermatologist
GMC Number 6025168

ENTUK

VIRTUAL BACO INTERNATIONAL
TRANSLATING RESEARCH - TRANSFORMING LIVES

Certificate of Attendance

This is to certify that

Leo Gundle

attended the

Virtual British Academic Conference in Otolaryngology (BACO) 10 – 12 January 2021

and has been awarded

2 CPD points

Signed

Professor Gerry O'Donoghue
BACO Master

Signed

Professor Hisham Mehanna
Academic Chair

Certificate of Attendance

This is to certify that

Leo Gundle

Attended the following educational event:

A to Z in Head and Neck conference - ENT day

Delivered in Conference format by:

AtoZ in Head and Neck Surgery

on

27th November 2021

The Royal College of Surgeons of England has awarded up to 7 CPD points for this event

Miss Emma Stapleton
MBChB, FRCS

Dr Thomas Ringrose
President and Co-Founder

Certificates and feedback powered by

MedAll

Certificate reference: 4S5S-RUQ8-5BYT-SSSN-P67U-H5BLL

SFOUK

Certificate of Attendance

This is to certify that

Leo Gundle

Attended the Student & Foundation Doctors in Otolaryngology (SFO) Conference 2021

on Saturday 9 October 2021

Signed

Mr Dheeraj Karamchandani
ENT Consultant
Chair of Students and Foundation
Trainees in Otolaryngology (SFO UK)

Signed B. Nirmal Kumar

Professor Nirmal Kumar
ENT UK, President

ENTUK

Accredited with 7 CPD points by ENT UK

Location: University Coventry and Warwickshire

eLOGBOOK

Standard Report (ordered by frequency)

Specialist :	Dr Leo Gundle (7750218)
Specialty :	Pan Specialty
Region :	Wessex
Date of Report :	17/11/2022
Filter :	No Filter
Operations Count :	63
Total records in this report :	63
Report date period :	11/12/2020 - 09/11/2022

consultant signature, Educational Supervisor

Medical Council of New Zealand Number 33070

Printed Justine Bradley

Date 18/11/22

Specialist : Dr Leo Gundle (7750218)

Date of Report : 17-Nov-2022

Filter : No Filter

eLOGBOOK

Consolidation Report

		A	S-TS	S-TU	P	T	O	PPT
General Surgery								
Appendicectomy	11	11	0	0	0	0	0	0
Paediatric appendicectomy	5	5	0	0	0	0	0	0
Biliary - cholecystectomy	3	3	0	0	0	0	0	0
Abscess - drainage (non-breast/anal/abdominal)	1	0	1	0	0	0	0	0
Biliary - cholecystectomy - exploration of CBD - lap	1	1	0	0	0	0	0	0
Hernia - inguinal	1	1	0	0	0	0	0	0
Ileostomy - defunctioning	1	1	0	0	0	0	0	0
Other - General	1	0	0	0	1	0	0	0
Urology - orchidectomy +/- insertion prosthesis	1	1	0	0	0	0	0	0
Laparotomy - small bowel resection	1	1	0	0	0	0	0	0
Neurosurgery								
Burr hole/craniectomy for subdural collection (incl CSDH)	1	0	1	0	0	0	0	0
Other peripheral nerve decompression	1	1	0	0	0	0	0	0
Otolaryngology								
# nose fracture reduction	3	1	0	0	2	0	0	0
Thyroidectomy Hemi	3	3	0	0	0	0	0	0
Flexible nasendoscopy (paediatric)	2	0	0	1	1	0	0	0
Nasal Cautery (emergency)	1	1	0	0	0	0	0	0
Laryngoscopy +/- FB removal (emergency)	1	0	0	0	1	0	0	0
Direct laryngoscopy	1	0	1	0	0	0	0	0
Microlaryngoscopy +/- biopsy	1	1	0	0	0	0	0	0
Laryngectomy	1	1	0	0	0	0	0	0

Justine Bradley 33.700

18/11/22

Specialist : Dr Leo Gundle (7750218)

Date of Report : 17-Nov-2022

Filter : No Filter

eLOGBOOK

Consolidation Report

		A	S-TS	S-TU	P	T	O	PPT
Radical Neck dissection	1	1	0	0	0	0	0	0
Neck dissection partial	1	1	0	0	0	0	0	0
Drainage of neck abscess	1	0	1	0	0	0	0	0

Plastic Surgery

Skin graft - SSG	4	3	1	0	0	0	0	0
Excision of SCC & SSG	2	1	1	0	0	0	0	0
Primary wound closure	1	0	1	0	0	0	0	0
Excision of BCC & direct closure	1	1	0	0	0	0	0	0
Excision of BCC & FTSG	1	1	0	0	0	0	0	0
Excision of MM & SSG	1	0	1	0	0	0	0	0
Inguinal - Sentinel node biopsy groin	1	1	0	0	0	0	0	0
Extensor - Zones 1-5 - Primary repair single extensor tendon zones 1-5	1	1	0	0	0	0	0	0
Extensor - Zones 1-5 - Primary repair multiple extensor tendons zones 1-5	1	0	0	0	1	0	0	0
Composite tissue lesion - Excision composite tissue lesion arm	1	1	0	0	0	0	0	0
Fracture fixation - Hand fracture fixation - Internal - Kirschner wire fixation of hand fracture	1	1	0	0	0	0	0	0
DIEP free flap	1	1	0	0	0	0	0	0
Debridement of lower limb wound	1	1	0	0	0	0	0	0

Justine Bradley
3070
18/11/22

Specialist : Dr Leo Gundle (7750218)

Date of Report : 17-Nov-2022

Filter : No Filter

eLOGBOOK

Consolidation Report

		A	S-TS	S-TU	P	T	O	PPT
Urology								
Exploration of scrotum	2	1	1	0	0	0	0	0

Justine Baldock
18/11/22
33070

Index Page

Name Leo

Surname Gundle

Oriel Pin 91629

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Signature- 

Date: 8th February 2023

DOMAIN 2 –

Quality improvement/ Clinical audit

[Insert evidence-here and continue overleaf if necessary]

Domain 2 Contents

Covid & Consent

Dr L Gundle, Mr C Aliozo, Mr M Ahmad

Background

CovidSurg

Tool 5: Consent to treatment, while COVID-19 is present in society

- First published: Tuesday 30 June
- This tool is part of our Recovery of Surgical Services Guidance
- Download this tool as a PDF

Royal College of Surgeons of England

Mortality if **nosocomial covid**

16.2%

Mortality if **pulmonary complication**

23.8%

Aims and Methods

1. Measure
2. Educate
3. Improve

Dr Leo Gundle
Leo.gundle@uhd.nhs.net
+44 (0) 7948361144

NHS
University Hospitals Dorset
NHS Foundation Trust

Covid & Consent

Dr L Gundle, Mr C Aliozo, Mr M Ahmad

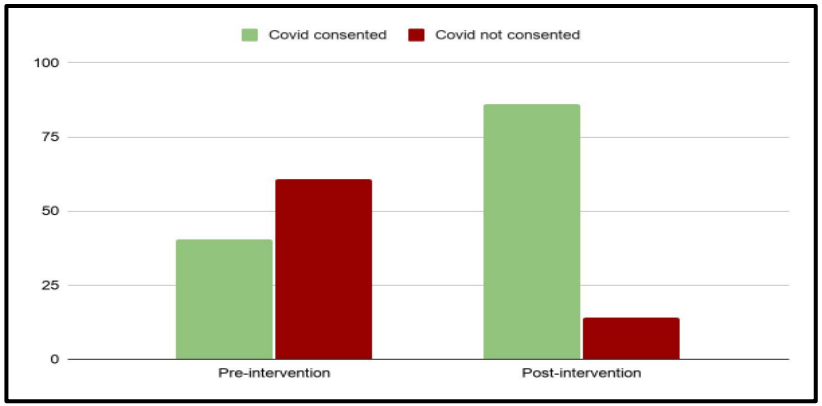
Results

Pre-Intervention

- 63 Patients audited
- 25 consented for covid risk
- 40.3%

Post-Intervention

- 50 Patients audited
- 43 Consented for covid risk
- 86.0%
- Re-loop 78.4%



Conclusion + Recommendations

1. Covid consent is mandatory
2. Simple intervention
3. Effective results
4. Informed consent
5. Easily replicable

University Hospitals Dorset
NHS Foundation Trust

University Hospitals Dorset
Poole Hospital
Longfleet Road
Poole, Dorset
BH15 2JB
United Kingdom

March 2022

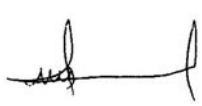
Dear Sir/ Madam,

For the purposes of his Core Surgical Training Application, I can confirm that I supervised Dr Leo Gundle in the following surgically-themed audit: Consent in the Time of Covid, within the general surgery department of Poole Hospital. This project involved auditing and improving the rates of consent for risks of covid ahead of an operation involving a general anaesthetic.

Leo led the project from the outset, and was involved in all parts of the audit's planning, data collection, data analysis, as well as implementing change by re-auditing a further two times, to a total of three loops. Leo was able to generate a meaningful improvement in this area, which he sustained across subsequent cycles.

Leo went on to present the results of this audit both at our local clinical governance meeting, and at a national conference: The Bristol Patient Safety Conference on 16th June 2021.

Yours sincerely,



Mr Mukhtar Ahmad
Consultant Colorectal and Robotic Surgeon
GMC No. 6050817

Subject: Fwd: Congratulations your poster has been accepted - please book and pay by 17th April to s your work in 2021 [#81]
Date: Monday, 12 April 2021 at 16:33:27 British Summer Time
From: Leo Gundle
To: Aliozo Chukwuebuka
Attachments: KJD BPSC logo 2021 1120 300dpi-400.jpg, RgRiQFeLPlcMc3VydmV5bW9ua2V5QgpgWIvSXWDDnNiyUh1pbmZvQGJyaXN0b2xwYXRpZW

From: katherine@bristolpatientsafety.com <katherine@bristolpatientsafety.com>
Sent: Monday, April 12, 2021 12:50
To: GUNDLE, Leo (UNIVERSITY HOSPITALS DORSET NHS FOUNDATION TRUST)
Subject: Congratulations your poster has been accepted - please book and pay by 17th April to secure your poster place Fwd: Share your work in 2021 [#81]

Dear Leo,

Congratulations you and co-authors have been accepted to present your poster at our national online conference on 16th June 2021. (Your abstract is in the email chain below for your reference)

What do I do next?

1. Email info@bristolpatientsafety.com immediately to confirm you will attend and confirm the name of the poster presenter(s)*

*Every presenter must pay for a delegate place - discounted rate applies

2. Book and pay the discounted rate of £159 (no VAT) for your conference delegate place here by 17th April: http://www.bristolpatientsafety.com/book.html - use your submission ID that is in the subject line of this email for the discounted rate on the online form
We have had an overwhelming response to the poster competition this year. Consequently if you do not book and pay for your place promptly we may need to reallocate your poster place. If this is an issue please call or text 07954 691 855.

If you find later you are unable to attend you can nominate a co-author to take your place by emailing info@bristolpatientsafety.com

What do I provide for my poster?

· You will be required to provide as a PDF file (A1 size, portrait orientation) of your poster by 19th May

· You will also provide 2 slides to accompany your 2-minute oral presentation by 19th May

I have more than one accepted poster presentation, do I need to register a conference ticket for each?
Yes, we have a strict policy that one ticket must be purchased for each individual poster presented. You will need a co-author(s) to book and pay to present your other poster(s).

Can I get a Poster Presenter Certificate of Attendance? Your certificate (oral poster presentation given at a national conference) will be sent to you via email within the week after the event. There will be a certificate for

co-presenters also.

How will the poster competition be run?

There are dedicated slots in the programme for the poster presentations. Posters will be presented in themed groups of 10. You will have two minutes to present your poster supported by 2 powerpoint slides which will be followed by a judge-led Q&A. Your poster PDF will be sent to the judge in advance of the event so they will have had a chance to review it prior to your poster presentation.

What are the timings?

The conference runs 09:00 to 17:15 on 16th June. Drop in session at 08:00 to check your tech.
Poster competition programme slots: you will be allocated to a group that runs either 10:40 to 11:55 or 14.45 to 16:00.

What are the prizes?

There will be a first and second prize in each group of 10 posters with certificates provided accordingly.

Plenaries and workshops

We have an exciting line up of leading experts in their field including a keynote from Sir Robert Francis QC with Rachel Power, CEO of the Patients Association and a diverse range of workshops to choose from (workshops will be finalised shortly). See programme here: http://www.bristolpatientsafety.com/programme.html

Important online conference requirements

You must access the conference platform using the Chrome Browser (it will not work on the Internet Explorer browser). We recommend you attend the conference from home as NHS trust IT systems can block access/ create technical problems. You will receive a link a few weeks before the conference; please register on the online event platform (Hopin) as soon as you receive that link.

Terms and conditions for the poster competition can be found here: http://www.bristolpatientsafety.com/poster-competition.htm

Katherine Dougherty
Organiser
Bristol Patient Safety Conference
www.bristolpatientsafety.com
07954 691 855

BRISTOL PATIENT SAFETY CONFERENCE 2021

Lead Author Title	Dr
Lead Author Name *	Leo Gundle
Lead Author Email address *	leo.gundle1@nhs.net
Job Title *	Doctor
Organisation *	University Hospital Dorset
Address *	Poole Hospital Longfleet Road Poole, Dorset BH13 2JB United Kingdom
Phone Number *	07948361144
Co-author names and job titles	Mr Aliozo, Surgical SpR Mr Ahmad, Surgical Consultant
Poster title *	Consent in the Time Of Covid: A closed loop audit and qu improvement
Project Introduction and Aims (120 words maximum) *	Covid infection presents a significant mortality risk in pat undergo a general anaesthetic. For this reason, the Royal Surgeons of England have recently mandated these risks as part of the consent process for operations under gene anaesthetic. Despite this mandate, we have found that di these risks were not consistently made in our departmen undertook a closed loop audit;
Project Methodology / PDSA Cycles (120 words maximum) *	we looked at consent forms which include consenting for We then performed our intervention (education and poste we re-audited, including a total of 113 audited records.
Project Results and Lessons Learnt (120 words maximum) *	Our results showed an improvement from 40.3% pre-edu 86% post-education, of consent forms addressing covid r conclude that clinicians nationally should be reminded of importance of including covid risks whilst consenting, an simple intervention yields effective improvements, such t may give proper informed consent.
Poster categories - options to tick more than one box please tick all relevant categories for your poster:	• Improving secondary care • Education and training
What topics in the above list are of greatest interest to you? Please state here:	Education and training. Improving secondary care.

BRISTOL PATIENT SAFETY CONFERENCE 2021

This is to certify that the following poster titled:

Consent in the Time Of Covid: A closed loop audit and quality improvement

Was presented at Bristol Patient Safety Virtual Conference on 16th June 2021

Oral presentation given at a national conference

By Dr Leo Gundle, Mr Chukwuebuka Aliozo

Authors:
Dr L Gundle, Mr C Aliozo, Mr M Ahmad

Katherine Dougherty
Organiser
Bristol Patient Safety Conference

KJD Communications, 72 West Broadway, Bristol, BS9 4SS
katherine@kjdcommunications.com 07954 691 855

KJD Communications

Index Page

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Surname Gundle

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Signature- 

Date: 8th February 2023

DOMAIN 3 – Presentations and Publications

[Insert evidence-here and continue overleaf if necessary]

Domain 3 Contents

1. Link to article on PubMed, citing abstract and PubMed ID
2. Publication acceptance letter
3. Copy of publication

> Int J Pediatr Otorhinolaryngol. 2021 Dec;151:110926. doi: 10.1016/j.ijporl.2021.110926. Epub 2021 Oct 1.

Stenting versus stentless repair for bilateral choanal atresia: A systematic review of the literature

Leo Gundle [1], Shilpa Ojha [2], Joseph Hendry [2], Harry Rosen [3]

Affiliations + expand

PMID: 34624631 DOI: 10.1016/j.ijporl.2021.110926

Abstract

Background: Bilateral choanal atresia requires prompt surgical intervention. Surgeons have historically used stents in the repair process, however their efficacy has come into question in recent years. We performed a systematic review to investigate, primarily, whether stents enjoy more favourable outcomes compared to stentless repair. We also explored the use of operative adjuncts, such as steroids, antibiotics, mitomycin C and KTP laser.

Methods: We performed a search of the Medline and Embase databases using a search strategy developed with the assistance of an academic librarian. Only full peer reviewed articles were included. Abstracts, posters, case reports and proceedings of academic conferences were excluded.

Results: We identified 48 unique articles for inclusion, composed of a meta-analysis, two randomised control trials and 45 case series. Pooled analysis of the two randomised control trials yielded no statistically significant difference in choanal patency between stented and stentless repair, but a statistically significant reduction in complications, specifically granulation tissue formation, was found in stentless repair. Data from case series were, overall, of mixed quality, making factors contributing to successful outcomes difficult to elucidate.

Conclusion: Overall, there is a lack of high quality evidence to support the use of either a stented or stentless approach to bilateral choanal atresia repair, however stentless repair may experience fewer complications. Operative techniques, such as the use of mucosal flaps, are worthy of future study. Authors call for future high quality randomised control trials to investigate this uncommon but important condition.

Keywords: CHARGE syndrome; Choanal atresia; Paediatrics; Stents.

From: em.ijporl.0.761713.1dedf80c@editorialmanager.com <em.ijporl.0.761713.1dedf80c@editorialmanager.com> on behalf of International Journal of Pediatric Otorhinolaryngology <em@editorialmanager.com>

Sent: Sunday, September 19, 2021 12:25 am

To: GUNDLE, Leo (UNIVERSITY HOSPITALS DORSET NHS FOUNDATION TRUST)

Subject: Your Submission IJPORL-D-21-00619R1

Ms. Ref. No.: IJPORL-D-21-00619R1
Title: Stenting versus stentless repair for bilateral choanal atresia: A systematic review of the literature
International Journal of Pediatric Otorhinolaryngology

Dear Dr Leo Gundle,

I am pleased to tell you that your work has now been accepted for publication in International Journal of Pediatric Otorhinolaryngology.

Your accepted manuscript will now be transferred to our production department and work will begin on creation of the proof. If we need any additional information to create the proof, we will let you know. If not, you will be contacted again in the next few days with a request to approve the proof and to complete a number of online forms that are required for publication.

Interactive Case Insights: The journal encourages authors to complement their case reports and other articles of an educational nature with test questions that reinforce the key learning points. These author created questions are submitted along with the article (new or revised) and will then be made available in ScienceDirect alongside your paper. More information and examples are available (at http://www.elsevier.com/about/content-innovation/interactive-case-insights). Test questions are created online (at http://elsevier-apps.sciverse.com/GadgetICRWeb/verification). Create the test questions, save them as a file to your desktop, and submit them along with your (new or revised) manuscript through EM. That's it! For questions, please contact icihelp@elsevier.com

Thank you for submitting your work to this journal.

With kind regards,

Joseph Kerschner, MD
Editor-in-Chief
International Journal of Pediatric Otorhinolaryngology

Comments to Authors:

Reviewer #1: To me the manuscript has significantly improved.

Reviewer #3: Concerns have been addressed.

#AU_IJPORL#

International Journal of Pediatric Otorhinolaryngology 151 (2021) 110926

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Stenting versus stentless repair for bilateral choanal atresia: A systematic review of the literature

Leo Gundle [a,*], Shilpa Ojha [b], Joseph Hendry [b], Harry Rosen [c]

[a] University Hospitals Dorset, Poole NHS Foundation Trust, UK
[b] Department of Ear, Nose and Throat Surgery, University Hospitals Bristol NHS Foundation Trust, UK
[c] Imperial College Healthcare NHS Trust, UK

ARTICLE INFO

Keywords:
Choanal atresia
Stents
Paediatrics
CHARGE syndrome

ABSTRACT

Background: Bilateral choanal atresia requires prompt surgical intervention. Surgeons have historically used stents in the repair process, however their efficacy has come into question in recent years. We performed a systematic review to investigate, primarily, whether stents enjoy more favourable outcomes compared to stentless repair. We also explored the use of operative adjuncts, such as steroids, antibiotics, mitomycin C and KTP laser.

Methods: We performed a search of the Medline and Embase databases using a search strategy developed with the assistance of an academic librarian. Only full peer reviewed articles were included. Abstracts, posters, case reports and proceedings of academic conferences were excluded.

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Conclusion: Overall, there is a lack of high quality evidence to support the use of either a stented or stentless approach to bilateral choanal atresia repair, however stentless repair may experience fewer complications. Operative techniques, such as the use of mucosal flaps, are worthy of future study. Authors call for future high quality randomised control trials to investigate this uncommon but important condition.

1. Introduction

Choanal atresia (CA) is a rare congenital condition characterised by a failure of breakdown of the buccopharyngeal membrane, leading to posterior nasal obstruction. It affects between 1 in 5000 to 1 in 8000 live infants. Atresia may be unilateral (60%) or bilateral (40%) [1]. Unilateral choanal atresia (UCA) may be asymptomatic at birth, and is often only diagnosed in later life. Bilateral choanal atresia (BCA), however, requires early surgical intervention; neonates are obligate nasal breathers, and the failure of patent choanae formation can lead to respiratory distress and hypoxia, requiring prompt surgical correction. CA can be bony, mixed, or membranous in nature, the most common form being mixed bony-membranous in approximately 70% of cases, with pure bony appearing in approximately 30% of cases [2].

CA often presents as an isolated defect, however it is also associated with syndromic presentations, most notably in CHARGE syndrome (50% have bilateral choanal atresia), Apert Syndrome, Treacher Collins, Crouzon, Trisomy 21 and 22q11 deletion [3].

Bilateral Choanal Atresia (BCA) has historically been managed via a variety of surgical techniques and approaches. These vary from transpalatal, transseptal, and transnasal, with most paediatric otorhinolaryngologists now opting for the endoscopic transnasal approach. Postoperative stenting in the management of BCA has been used as a means to maintain choanae patency. Stenting protocols vary greatly amongst paediatric otorhinolaryngology centres with considerable variation in stent duration, type of stent material, and the use of adjuncts such as steroids, antibiotics and irrigation.

In recent times, as demonstrated by Table 1, the use of stents has fallen out of fashion, with recent literature advocating stentless BCA repair.

* Corresponding author. Poole General Hospital, Longfleet Road, Poole, Dorset, BH15 2JB.
E-mail address: leo.gundle1@nhs.net (L. Gundle).

https://doi.org/10.1016/j.ijporl.2021.110926
Received 9 May 2021; Received in revised form 23 August 2021; Accepted 18 September 2021
Available online 1 October 2021

Table 1
Demographics.

First Author **and year**	Study Design	Sample Size	No. With Stents	Duration of stenting	Age	Gender	CHARGE	Other congenital abnormalities	Bony atresia	Membranous atresia	Mixed atresia	Initial primary success
Moreddu, 2018 [4]	Case series	37	36	27.7 days mean **	8 days–7 months	26 female, 11 male	10	13	24	1	12	25, 67.6%
Tomoum, 2018 [5]	Randomised Controlled Trial	72	30	2–3 weeks	3–10 days	47 female, 25 male	0	13	26	0	46	81% group A 83% group B
Gulşen, 2017 [6]	Case series	20	20	1–4 weeks	12 <6/12, 8 >6/12	Unknown	0	9				7, 35%
Tatar, 2017 [7]	Case series	9	1	<2 weeks	2 days −13 years		0	0	3[a]	0	8[a]	1, 33.3% stented 5, 62.5% unstented
Karligkiotis, 2017 [8]	Case series	19	0	N/A	Mean 2 years	Unknown		15	Unknown	Unknown	Unknown	Unknown; secondary cases included
Wolf, 2016 [9]	Case series	3	2 (unclear)		4 days-1.4 years	2 female, 1 male	Unknown	Unknown	1	0	2	2, 100% in stented 1, 100% in unstented
El-Anwar, 2016 [10]	Case series	25	0	N/A	3–15 days	7 female, 18 male	1	6	4	0	21	
Wormald, 2016 [11]	Case series	5	0	N/A	5 days-5 years	4 female, 1 male	0	2	1	0	4	5, 100%
Strychowsky, 2016 [12]	Meta-analysis	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Riepl, 2014 [13]	Case series	6	6	6–8 weeks	4–42 days	4 female, 2 male	0	1	0	2	4	1, 20%
Kinis, 2014 [14]	Case series	18	18	3–21 days	3–110 days (mean 37.2)	12 female, 6 male	3[a]	5	5	0	13	6, 33.3%
SaAfan, 2012 [15]	Randomised Controlled Trial	20	10	Max 4 weeks	mean 4 days	13 female, 7 male	0	0	8	2	10	
Freitas, 2012 [16]	case series	23	20	Mean 75 days	0–32 days	18 female, 5 male	6	16	23(bony/ mixed)	0	23(bony/ mixed)	14/20, 70%
Uzomefuna, 2012 [17]	Case series	12	12	4–14 weeks	1 day-12 weeks	9 female, 3 male	4	0	0 (7 unspecified)	1 (7 unspecified)	4 (7 unspecified)	3/12, 25% overall. 1/5, 20% restenosis of mitomycin + stent subgroup
El-Ahl, 2012 [18]	case series	7	0		3–15 days	4 female, 3 male	0	2	2	0	5	7, 100%
Hassan, 2011 [19]	Case series	10	10	6 weeks	2 days–2 months	7 female, 3 male	1	2	0	0	10	3/10, 30%
Bedwell, 2011 [20]	case series	2	1	10 days	2 weeks - 2 months	2 female	0	2	Unknown	Unknown	Unknown	0, 0% Stented 0, 0% unstented
Bozkurt, 2010 [21]	Case series	12	12	3 weeks	3–7 days	9 female, 3 male	0	0	0	0	12	9, 75%
Stieve, 2009 [22]	Case series	5	5	Unknown	1–20 days	4 female, 1 male	2	5	0	0	5	0
Acar, 2009 [23]	Case series	10	10	Mean 3 months	1–26 days	5 female, 5 male	1	3	Unknown	unknown	unknown	9, 90%
Ibrahim, 2009 [24]	Case series	11	0		2–27 days	7 female, 4 male	0	3	2	0	9	8, 72.7%
D'Eredita, 2008 [25]	Case series	4	4	6 weeks	3–5 days	Unknown	0	6	4	0	0	2/4, 50%
Zuckerman, 2008 [26]	Case series	9	4	4–6 weeks	5–15 days	4 female, 5 male	1	1	Unknown	Unknown	Unknown	1, 25% in stented. 5, 100% in unsented.
Nour, 2008 [27]	Case series	14	14	3–4 weeks	2–25 days	10 female, 4 male	2	1	2	0	12	14, 100%
	Case series	6	6	2–4 weeks	**	3 female, 3 male	4		2	1	3	3, 50%

(*continued on next page*)

Table 1 (*continued*)

First Author **and year**	Study Design	Sample Size	No. With Stents	Duration of stenting	Age	Gender	CHARGE	Other congenital abnormalities	Bony atresia	Membranous atresia	Mixed atresia	Initial primary success
Sharma, 2006 [28]								1 (CHARGE and VATER)				
Cedin, 2006 [29]	Case series	3	0	N/A	4–60 days	2 female, 1 male	Unknown	Unknown	3	0	0	3, 100%
Kumar, 2005 [30]	Case series	2	2	4 weeks	Unknown	Unknown	0	0	Unknown	unknown	unknown	2, 100%
Gujrathi, 2004 [31]	case series.	52	52	3 months	median 4 days; mean 11.1 days	31 female, 21 male	22	7				50 (96.15%)
Kubba, 2004 [32]	Case series	23	23	6 weeks	unknown	14 female, 7 male	8	4				18, 78.3%
Pasquini, 2003 [33]	case series	3	3	3–6 days	7–20 days	1 female, 2 male	2	0	Unknown	Unknown	Unknown	3 (100%)
Mcleod, 2003 [34]	Case series	2	0	N/A	1–4 years	**	0	1	0	0	2	2, 100%
Panda, 2002 [35]	case series	4	4	4–6 weeks	4-12 (presumed days, units not given)	2 female, 2 male	0	4	3	1	0	3, 75%
Abbeele, 2002 [36]	Case series	14	0	N/A	3–25 days in bilateral	24 female, 16 male (including unilateral atresia patients)	6[a]	10[a]	19[a]	0	21[a]	10, 71%
Cedin, 2002 [37]	case series	2	0	N/A	4 days −13 years[a]	2 female	1[a]	0	2	0	2 (bony/ mixed)	1, 50% (not requiring revision)
Pototschnig, 2001 [38]	case series	7	7	6 months	<7 days	unknown	Unknown	Unknown	Unknown	Unknown	Unknown	7, 100%
Nechama, 2001 [39]	case series	2	2	8–12 weeks	5 days-8 years	1 female, 1 unknown	0	0	2	0	0	1, 50% (not requiring revision)
Dedo, 2001 [40]	case series	15	15	2–3 weeks	4 days - 15 months	unknown	3	0	Unknown	Unknown	Unknown	2, 14.3% (without revision)
Holland, 2001 [41]	Case series	11	11	2–8 weeks	7 days - 4 years	unknown	7	5 (2 with CHARGE and other abnormalities)	9	0	2	1, 50% with mitomycin 0/9 without mitmycin (without repeat dilatation)
Stamm, 2001 [42]	case series	11	0	N/A	unknown	8 female, 3 male	Unknown	Unknown	0 (3LFU)	2	6	8, 72.7%.
Josephson, 1998 [43]	Case series	5	5	6 weeks	2 days-9 years	3 female, 2 male	0	3	4 (1 unknown)	0	0	3, 60%
Morgan, 1990 [44]	Case series	35	35	6 weeks	Neonatal. 1 at 9months	19 female, 16 male	Unknown[a]	Unknown[a]	29	6	0	Initial success, 6, 17.1%. (Long term success with dilatations reported in 28)
Richardson, 1988 [45]	case series	37	37	6–12 weeks	Neonate - 8 years	**	Unknown	16	23	0	13	Overall 26 70.3%. Transnasal 16, 64%. Transpalatal 10, 83%
Krespi, 1987 [46]	case series	3	3	10–12 weeks	3–28 months	unknown	Unknown	Unknown	unknown	unknown	unknown	3, 100%
Prescott, 1986 [47]	case series	14	14	4–12 weeks	neonatal-6 weeks	unknown	0	7	**			
SchwarTz, 1986 [48]	case series	13	12	5 days-5 months	<1 month	7 female, 6 male	0	9	9	3	0	8, 61.5%

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Table 1 (*continued*)

First Author and year	Study Design	Sample Size	No. With Stents	Duration of stenting	Age	Gender	CHARGE	Other congenital abnormalities	Bony atresia	Membranous atresia	Mixed atresia	Initial primary success
Samuel, 1985 [49]	case series	28	28	3 months	neonates – 2 months	17 female, 11 male	0	1	25	3	0	28, 100%
Osguthorpe, 1982 [50]	Case series	14	10	6 weeks	2 days - 2 years				5	0	3	8, 80%
Lantz, 1981 [51]	Case series	4	4	1–3 months	7 days - 6 months	Unknown	0	1	unknown	unknown	unknown	3, 75%.

[a] Data for unilateral and bilateral not reported separately.

The objective of this systematic review is to examine the literature to assess the efficacy of stenting compared with stentless BCA repair, and establish if one approach holds significant merit over the other. We hope results will help guide the paediatric otorhinolaryngologist.

2. Methods

A systematic review of the Medline database (1946 to present) and Embase (1980 to present) was conducted on 2nd February 2020. The search strategy was developed with the help of an academic librarian. The search strings included choanal atresia, stent*, surg*, repair* and manage*. These were combined with Boolean operators. Results were limited to English language where possible. Only full peer reviewed articles were included. Abstracts, posters, case reports and proceedings of academic conferences were excluded. Duplicate results were filtered and removed. Reference lists were cross-referenced for additional relevant studies.

3. Results

3.1. Literature search

We identified 138 unique articles published between 1946 to present. 90 did not meet our inclusion criteria, and were excluded for reasons such as being unrelated to the management of bilateral choanal atresia (BCA), lacking sufficient detail, not investigating our target population etc. A meta-analysis and two randomised control trials were identified, with the remainder consisting of case series (Figs. 1 and 2).

3.2. Randomised control trials

See Tables 3 and 4

3.3. Analysis

3.3.1. Randomised control trials (RCTs)

Overall, there is insufficient evidence demonstrated in these RCTs, either individually or pooled, to recommend either stenting or stentless BCA repair; sample sizes and effect size are too small to be statistically significant, and both papers suffer from confounding.

Pooled data analysis showed that a statistically significant reduction in granulation tissue was found in unstented patients (See Fig. 3). This result however should be interpreted with caution, as it was not the primary outcome of the study and therefore is at risk of multiplicity.

3.3.2. Case series

45 papers defined as case series were included in this article. Each paper was analysed for patient numbers, the use of stents, definition and rates of primary success, complications, and the use of surgical adjuncts such as antibiotics and steroids.

The vast majority of the studies included in our search are observational and non-comparative. There is also considerable variation between study designs, type and duration of stenting. That being said, there are some general trends which are apparent and warrant further investigation.

What constituted successful surgery varied between studies and was not always defined. Some authors reported surgical success even when multiple dilatations or minor revisions were required. The length of follow up also varied but was most frequently deemed successful if choanal patency was maintained at 1 year after surgery. The relative diameter of choana that defined patency also differed and was variably described so specific measurements were not included in our definition. We define success as maintained choanal patency at last follow up without recurrent symptoms and without the need for repeat dilatation or revision.

Through our analysis of the large number of case series, we were

Table 2
Methods, outcomes and complications.

First author and year	Study Design	Sample Size	No. With Stents	Duration of stenting	Stent material	Initial primary success	Complications: Number of patients (%)	Flap preservation	Saline irrigation	Steroids	Antibiotics	Mitomycin	KTP laser
Moreddu, 2018	Case series	37	36	27.7 days mean	Unknown	25, 67.6%		No	Unknown – multiple techniques	Unknown – multiple techniques	Unknown – multiple techniques	Yes (unknown number)	Yes [2]
Tomoum, 2018	Randomised Controlled Trial	72	30	2–3 weeks	Portex ET tube	81% group A 83% group B	[a]Group A: Granulation tissue 12/42 (28.6%) Group B: Granulation tissue: 16/30 (53.3%)	[a]Group A: yes Group B: no	Yes – twice daily	Yes – 1 month	No	No	No
Gulşen, 2017	Case series	20	20	1–4 weeks	Silicone tubes	7, 35%	Soft palate perforation: 1/50 (2%)[b] Minor bleeding, stent dislocation, stent obstruction, and oral feeding problems: unknown	Yes	Yes	No	Yes (stented patients)	No	No
Tatar, 2017	Case series	9	1	<2 weeks		1, 33.3% stented 5, 62.5% unstented		Yes				No	
Karligkiotis, 2017	Case series	19	0	N/A	N/A	Unknown; secondary cases included	Post op bleeding: 2/84 (2.4%)[b] Hard palate perforation: 1/84 (1.2%)[b]	Yes	Yes – twice daily	No	No	No	No
Wolf, 2016	Case series	3	2 (unclear)	**	Silicone catheter	2, 100% in stented 1, 100% in unstented	None	No	No	No	No	No	No
El-Anwar, 2016	Case series	25	0	N/A	N/A		Hard palate perforation: 1 (4%)	No	Yes	No	Yes	No	No
Wormald, 2016	Case series	5	0	N/A	N/A	5, 100%	Intra-operative bleeding and transfusion:1/17 (5.9%)[b] Post op transfusion: 1/17 (5.9%)[b] Pneumonia: 1/17 (5.9%)[b] Failed extubation: 1/17 (5.9%)[b] Epistaxis with readmission: 1/17 (5.9%)[b]	Yes	No	No	No	No	No
Strychowsky, 2016	Meta-analysis	N/A	N/A	N/A									
Riepl, 2014	Case series	6	6	6–8 weeks	ET tubes	1, 20%	Granulation: 3 (60%)	Yes	Yes	No	No	No	No
Kinis, 2014	Case series	18	18	3–21 days	Orotracheal ET tubes	6, 33.3%	Soft palate perforation: 1 (6%)	No	Yes	No	Yes (stented patients for duration of stenting)	No	No
Safaan, 2012		20	10					No	Yes	No	Yes	No	No

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Table 2 (*continued*)

First author and year	Study Design	Sample Size	No. With Stents	Duration of stenting	Stent material	Initial primary success	Complications: Number of patients (%)	Flap preservation	Saline irrigation	Steroids	Antibiotics	Mitomycin	KTP laser
	Randomised Controlled Trial			Max 4 weeks	Modified ET tube		Stent group: Granulation:5 (50%) Stent dislodgement: 1 (10%) Premature protrusion: 1 (10%) Erosion of nares: 1 (10%) Non-stented group: Closure: 3 (30%) Granulation: 2 (20%) Haemorrhage: 1 (10%)						
Freitas, 2012	case series	23	20	Mean 75 days	Modified ET tube	14/20, 70%	Skull base perforation with SAH: 1 (4.3%) Palatal laceration: 2 (8.7%) Stent blockage: 4 (17.4%) Alar pressure ulcer: 1 (4.3%) Stent dislodged: 3 (13%)	Mucosa preserved	No	No	No	No	No
Uzomefuna, 2012	Case series	12	12	4–14 weeks	Polyvinyl chloride stent	3/12, 25% overall. 1/5, 20% restenosis of mitomycin + stent subgroup	None	No	No	No	No	Yes (in 5/12)	No
El-Ahl, 2012	case series	7	0	N/A	N/A	7, 100%	Palatal perforation: 1 (14.3%)	No	Yes	No	Yes (1 week)	No	No
Hassan, 2011	Case series	10	10	6 weeks	ET tube	3/10, 30%	Palatal fistula: 1 (10%)	No	No	No	No	Yes	No
Bedwell, 2011	case series	2	1	10 days	Cut ET tube or nasal trumpet	0, 0% Stented 0, 0% unstented	Required repeat dilatation: 2 **	No	Yes (stented)	No	No	Used in 1 unilateral CA patient	No
Bozkurt, 2010	Case series	12	12	3 weeks	Unknown	9, 75%	None	Yes	Yes	No	Yes	Yes – in 4/12	No
Stieve, 2009	Case series	5	5	Unknown	Silicone tubes	0	Tube dislocation: 5 (100%) Septum perforation 1 (20%)	No	No	No	No	No	No
Acar, 2009	Case series	10	10	Mean 3 months	ET tube	9, 90%	Granulation tissue: 1 (10%)	No	Yes	No	No	No	No
Ibrahim, 2009	case series	11	0	N/A	N/A	8, 72.7%	Mid nasal synechiae: 3 (27.3%)	Yes	Yes	Yes	Yes (IV and oral)	No	No
D'Eredita, 2008	Case series	4	4	6 weeks	Portex ET tube	2/4, 50%	Granulation: 1 (25%)	No	No	No	Yes (1 week)	No	Yes (contact diode)
Zuckerman, 2008	Case series	9	4	4–6 weeks	ET tube	1, 25% in stented. 5, 100% in unsented.	None	No	Yes (stented patients)	No	Yes (topical drops)	No	No
Nour, 2008	Case series	14	14	3–4 weeks	ET tube	14, 100%		Yes			Yes	No	No

(*continued on next page*)

Table 2 (*continued*)

First author and year	Study Design	Sample Size	No. With Stents	Duration of stenting	Stent material	Initial primary success	Complications: Number of patients (%)	Flap preservation	Saline irrigation	Steroids	Antibiotics	Mitomycin	KTP laser
							Granulation tissue 4/14 (28.6%)		Yes (1 month for stented)	Yes (1 month)			
Sharma, 2006	Case series	6	6	2–4 weeks		3, 50%	None	No	Yes	No	No	Yes (some)	Yes (some)
Cedin, 2006	Case series	3	0	N/A	N/A	3, 100%	None	Yes	Yes	No	Yes (oral)	No	No
Kumar, 2005	Case series	2	2 (4 weeks)	4 weeks	Portex PVC ET tubes	2, 100%	None	No	Yes	No	Yes – for stented patients	No	No
Gujrathi, 2004	case series.	52	52	3 months	ET tube	50 (96.15%)	Septal perforation: 1/52 (1.9%) Delayed transpalatal repair: 2/52 (3.85%)	No	Yes	Yes	Yes	No	No
Kubba, 2004	Case series	23	23	6 weeks	Portex ET tube	18, 78.3%	Pneumonia and death: 1 (4.3%)	No	No	Yes [4]	No	Yes [15]	Yes [8]
Pasquini, 2003	case series	3	3	3–6 days	ET tube	3 (100%)	Granulation tissue: 3 (21.4%)[b]	Yes	Yes – saline spray	No	Yes - topical	No	No
Mcleod, 2003	Case series	2	0	N/A	N/A	2, 100%	None	No	Yes – saline mist	Considered	Considered	Yes	No
Panda, 2002	case series	4	4	4–6 weeks	Portex ET tube	3, 75%	HAP and death: 1 (25%) Extrusion of stent requiring revision: 2 (50%)	No	No	No	No	No	No
Abbeele, 2002	Case series	14	0	N/A	N/A	10, 71%	None	No	No	No	No	Yes [1]	No
Cedin, 2002	case series	2	0	N/A	N/A	1, 50% (not requiring revision)	Mucosal synechia: 1 (50%)	Yes	Yes	No	Yes – 1 week	No	No
Pototschnig, 2001	case series	7	7	6 months	Silicone tracheal suction tube	7, 100%	Secretory OM: 1 (14.3%)	No	No	No	No	No	Yes
Nechama, 2001	case series	2	2	8–12 weeks	Silastic suction tube	1, 50% (not requiring revision)	Granulation tissue: 2/7 (28.6%)	Yes	Yes	No	Yes – 48 h IV cefuroxime	No	No
Dedo, 2001	case series	14	14	2–3 weeks	Flat Teflon keel	2, 14.3% (without revision)	Nasal laceration: 1 (7.1%)	Yes	No	No	No	No	Co2 laser
Holland, 2001	Case series	11	11	2–8 weeks	ET tube	1, 50% with mitomycin 0/9 without mitomycin (without repeat dilatation)	Granulation tissue: 11/15 (73%)[b] (3 times more likely in control group)	Yes?	Yes	No	No	Yes	No
Stamm, 2001	case series	11	0	N/A	N/A	8, 72.7%.	Nasal vestibule stenosis secondary to trauma: 1/33 (3%)[b] Local infection: 30%[b]	Yes	Yes	Yes - topical	Yes – topical	No	No
Josephson, 1998	Case series	5	5	6 weeks	Custom self-inflating silastic with foam cuff	3, 60%	Granulation tissue: 1 (20%)	No	Yes	No	Yes	No	No
Morgan, 1990	Case series	35	35	6 weeks	Portex ET tube	Initial success, 6, 17.1%. (Long term success with	Columella laceration: 4/50[b] (8%) Palatal fistula: 4/50	No	No	Yes – 2 weeks post stent removal	No	No	No

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Table 2 (*continued*)

First author and year	Study Design	Sample Size	No. With Stents	Duration of stenting	Stent material	Initial primary success	Complications: Number of patients (%)	Flap preservation	Saline irrigation	Steroids	Antibiotics	Mitomycin	KTP laser
						dilatations reported in 28)	(8%)[b] Submucosal tunnel: 1/50 (2%)[b]						
Richardson, 1988	case series	37	37	6–12 weeks	Portex ET tube	Overall 26 70.3%. Transnasal 16, 64%. Transpalatal 10, 83%	Unknown	Yes	Yes	No (Not routinely but in purulent rhinitis)	No (Not routinely but in purulent rhinitis)	No	No
Krespi, 1987	case series	3	3	10–12 weeks	Polyvinyl ET tube	3, 100%	Unknown	No	Yes	No	Yes - topical	No	No
Prescott, 1986	case series	14	14 (4–12 weeks)	4–12 weeks	Silastic tube		Drill into palatine atery: 1 (7.1%)	Yes	Yes	No	No	No	No
Schwarz, 1986	case series	13	12	5 days-5 months	ET tube or #14 French catheter	8, 61.5%	CSF leak and meningitis: 1 (5.6%) Posterior nasal septal erosion due to stent: 1 (5.6%)	Unknown	Unknown	Unknown	Unknown	No	No
Samuel, 1985	case series	28	28	3 months	Portex ET tube	28, 100%	None	Yes	Unknown	Unknown	Unknown	No	No
Osguthorpe, 1982	Case series	14	10 (6 weeks)	6 weeks	ET tube	8, 80%	Nasal septal perforation: 1(10%)	Yes	Yes	No	No	No	No
Lantz, 1981	Case series	4	4	1–3 months	Polyvinyl ET tube	3, 75%.	Alar irritation and early removal of stent: 1 (25%)	No	No	No	No	No	No

[a] Group A - Flaps preserved + no stenting, Group B - flaps not preserved + stenting.
[b] Including unilateral cases.

able to draw some conclusions:

3.3.3. *Stenting has no effect on primary patency*

Good outcomes have been reported in case series for both stented and unstented patients. Two recent notable papers published in 2016 and 2017 present data on 25 and 19 unstented patients respectively (8, 10). Primary success, defined as choanal patency of >50% plus absence of nasal symptoms, was reported as 84% and 96% each, showing that stents are not necessarily required for satisfactory outcomes.

Gujrathi et al.(2004) (31) published a case series of 52 stented patients, with primary success, defined as patency at one year follow-up, of 96.2%. Samuel et al.'s (1985) (49) series of 28 stented patients reported excellent outcomes with 100% patency at one year follow up. This operative protocol included the preservation of choanal mucosa, a technique which is commonly utilised in stentless repair. Follow up times and definition of primary success were not clearly defined in this paper.

Case series' authors variably measured success rates by direct vision under general anaesthetic, which itself could be considered a minor revision surgery. Overall, it was felt that since this procedure was observational rather than interventional, it shouldn't prohibit results found in this paper from defining these cases as achieving primary patency.

Within the limits of our analysis, it is our impression that restenosis and complication rates are lower in studies which do not use stents as part of their operation protocol. Moreover, it appears that the preservation of mucosal flaps is associated with better outcomes in stented patients [5,7,8,16].

3.3.4. *Granulation tissue rates are higher in stented patients*

A variety of complications have been reported in published case series. Very few studies report infection, and complications such as damage to local structures and fistula formation tend to be scattered or appearing in isolation. A postoperative complication common to a number of protocols is that of granulation tissue formation. A complete report of complications can be found in Table 2.

Granulation tissue may form as part of the mucosal healing process and may be problematic for patients due to mucosal irritation, pain and choanae obstruction. For these reasons, surgeons may seek to minimise granulation tissue formation by preserving mucosal flaps, thus reducing tissue damage, or by diminishing the immune response through the use of steroids. Granulation tissue was poorly defined across the literature and its assessment either not specified or being achieved through nasolaryngoscope, either in clinic or under general anaesthetic.

Overall, granulation tissue formation has not been widely experienced in published case series. In stented patients, rates of granulation tissue formation range from 0% to 28.6% [27,28,31,49]. This contrasts with unstented protocols; granulation tissue formation was not reported at all in included case series of unstented patients [8,10,11,27,29,35,39,41,46,52]. It seems likely therefore that a stent, as a foreign object, may complicate the process of healthy mucosal healing post-surgery.

Many stented protocols with lower rates of granulation tissue formation included the use of steroids as post-operative management. One case series of 5 patients, which did not include steroid use in the postoperative period, reported 60% of its patients developing complicating granulation tissue formation [43]. Steroid use therefore may be beneficial for reducing rates of complicating granulation tissue, however we cannot draw firm conclusions from this small case series.

3.3.5. *Endoscopic transnasal approach is the preferred method*

The most popular surgical approach in recently published cases is the endoscopic transnasal approach. Several, predominantly less

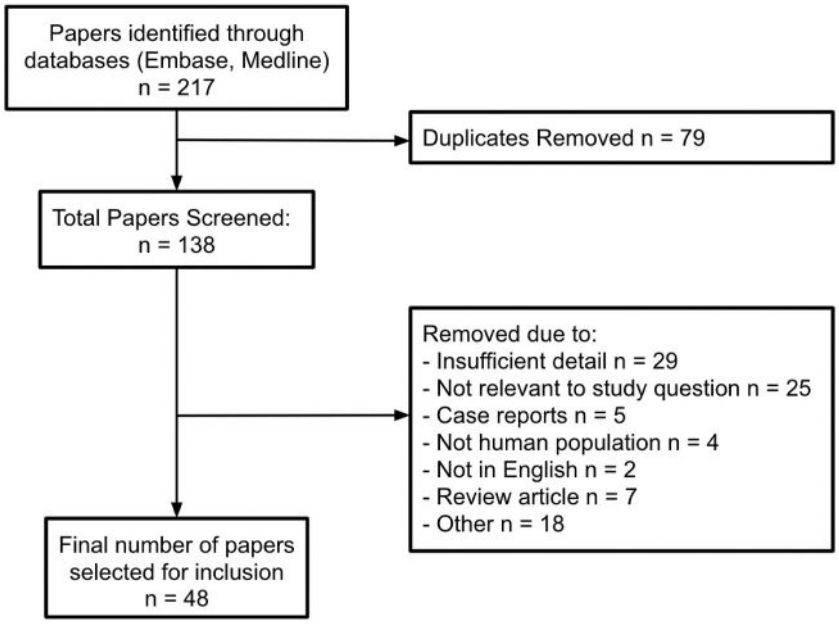

Fig. 1. PRISMA flow chart of paper screening and results.

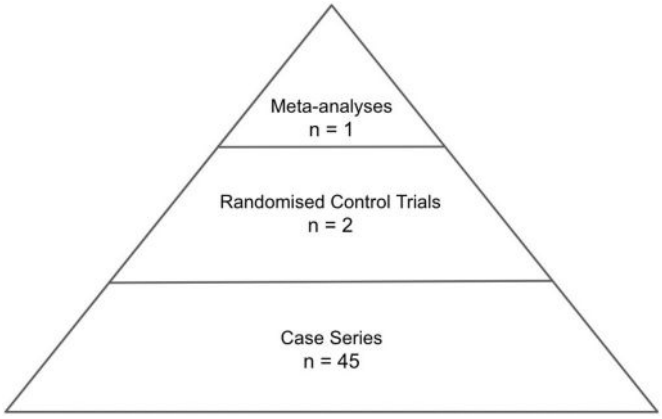

Fig. 2. Summary of hierarchy of evidence.

recent papers opted for a transpalatal approach. Surgeons also vary in their technique of new choanae formation; some opt for a puncture and serial dilatation strategy, with others using powered instruments to drill through the atresia(23, 31). It isn't clear which combinations of the above strategies enjoys more favourable outcomes.

A small number of the papers in our review included patients undergoing transseptal repair. Three of these included transnasal and transseptal approaches. Both Richardson et al. (1988) (45) and Osguthorpe et al. (1982) (50) reported marginally increased rates of re-stenosis using the transnasal approach compared with the transseptal (40% vs 17% and 10% vs 0% respectively), albeit within small sample sizes. Prescott (1986) (47) expressed a preference for transnasal repair, but outcome measures were not clearly defined. In contrast, Holland et al. (2001) (41) utilised a transpalatal approach for all patients with bilateral choanal atresia with success in only 22% (2/9) cases. Moreddu et al. (2019) (4) also reported higher primary success in patients with bilateral choanal atresia with the transnasal approach with only 45% (9/20) requiring a second stage surgery compared to 77.8% (42/54) in the transpalatal approach. However, in this, and the other studies identified in this review, the surgical approach was not the primary variable and there is a paucity of information describing differences in long term follow up and complication rates. The transpalatal approach was adopted for several of the patients in these studies as they were older and had previously undergone failed transnasal procedures. Increased rates of significant complications such as fistula and dentoalveolar growth abnormalities amongst patients undergoing transpalatal repair have been well documented in previous literature and has contributed to the move away from this approach as a primary intervention in neonates (31, 53).

3.3.6. Mucosal flap preservation is associated with a lower complication and re-stenosis rate

Mucosal flap preservation was a technique variably used through published case series. It appears that flap preservation is associated with more favourable outcomes and lower complication rates; Samuel et al. (1985) (49) and Osguthorpe et al.(1982) (50) reported success in their stented patients (sample sizes of 28 and 14) with the preservation of flaps of 100% and 85.7% respectively. Contrastingly, Uzomefuna et al. (2012) (17) and Kinis et al.(2014) (14) did not preserve mucosal flaps and reported comparatively poorer outcomes with primary success rates of 25% and 33.3% in their patient cohorts of 12 and 18 patients respectively.

However, one case series by Gulşen et al.(2017) (6) only reported primary success of 35% in their patient group, in which mucosal flaps were preserved. Weekly stent removal and long-term stenting (greater than six months in some cases) were, however, used in this case series, thus trauma may have played a role in the comparatively high rates of re-stenosis.

3.3.7. Removal of the vomer bone may improve success rate

Some authors attribute surgical success due to vomer removal: Samuel et al.(1985) (49) and El-Anwar et al.(2016) (10) reported successes of 100% in 28 patients and 96% in 25 patients respectively, both of whom removed part or all of the patient's vomer intraoperatively. Surgery was deemed successful if there was less than 50% reduction in the diameter of the new choana and the patient maintained easy nasal breathing and oral feeding without interruption. However, flap preservation, post-operative steroids, antibiotics and stenting were also variably used between these two reports; thus we cannot draw any firm

Table 3
RCT design and results.

Study	Sample Size	Intervention	Adjuncts	Complications	Outcome
Saafan et al., 2012 [15]	20	Endoscopic transnasal without mucosal preservation ± stenting	Antibiotics, regular irrigation, weekly surgical cleaning	Choanal stenosis P < 0.001 - Stent group: 40% - Unstented group: 20% Granulation tissue P < 0.001 - Stent group: 50% - Unstented group: 20%	80% success in stented group. 70% success in unstented group. **P>0.05**
Tomoum et al., 2018 [5]	72	Endoscopic transnasal with either mucosal obliteration + stenting, or stentless choanae formation with mucosal flap preservation	Regular irrigation, one month topical steroids	Choanal stenosis **P>0.05** - Stent group: 30.3% - Unstented group: 21.4% Granulation tissue **P<0.05** - Stent group: 53.3% - Unstented group: 28.6%	83% success in stented group. 81% success in unstented group. **P>0.05**

Table 4
RCT analysis and evaluation.

Study	Cochrane risk of bias [52]	Detsky RCT quality [53]	Multiplicity risk	Other comments	Our Overall assessment of quality
Saafan 2012	High risk	15/21	High	1. Use of combined antibiotics, irrigation and surgical cleaning has a high risk of confounding. 2. Study does not have requisite power to prove true positive due to small sample size. 3. Post operative protocol adherence was not reported	Poor
Tomoum 2018	High risk	15/21	High	1. Use of combined steroids and irrigation has a high risk of confounding. 2. Unbalanced study arms meant that requisite power to prove true positive was not achieved. 3. Post operative protocol adherence was not reported	Poor

conclusions from these studies.

3.3.8. *Variable outcomes with the use of mitomycin C and KTP laser*

We were able to identify ten papers which include the use of mitomycin C or KTP laser within their operative protocol ([17,19,21,28,32,34,36,38,41,54]).

Holland et al.(2001) (41) performed BCA repair on 11 patients, 2 of whom were also treated with mitomycin C. Of the whole cohort, primary success was achieved in 1 patient, who was treated with mitomycin C. This case series' authors concluded that mitomycin C has a statistically significant association with successful management (P = 0.006). Contrastingly, in a series of 23 children, 15 of which were treated with mitomycin C, Kubba et al.(2004) [32] were unable to find a statistically significant association between surgical success and mitomycin.

Kubba et al. also utilised KTP laser in 8 children as part of their management protocol, reporting that nasal symptom rates recurred more frequently in this subgroup. KTP laser and stenting were used in a case series of 7 children by Pototschnig. et al. (2001) [38] who reported primary success in all 7 of their patients. Length of follow up in this study varied from a number of months to 3.5 years, potentially increasing the risk of bias due to incomplete follow-up.

Whilst the use of more novel tools such as mitomycin C and KTP laser may yield interesting results, their efficacy has yet to be demonstrated in any larger or high quality study. More data is therefore required to establish their value. On the whole, these case series included small numbers of patients thus we are unable to draw definitive conclusions.

3.3.9. *Confounding factors*

We were unable to draw conclusions on stent duration, due often to varying lengths of stenting protocols within studies(17, 48, 51, 52). Moreover, stent duration varied on a continuum, making it difficult for authors to neatly resolve protocols into "short-short" or "long-term". Furthermore, the effect of antibiotics, steroids and irrigation regimes were difficult for authors to discern; on the whole little detail into the length of time and rates of compliance of these interventions were included in published articles.

Whilst not a confounding factor per se, authors found considerable variation in case series' definition of primary success. For example, some papers defined choanae as being of >50% patency, as well as no nasal symptoms at follow up as a success, whereas other papers reported primary successes in patients who received re-dilations. Inconsistency in reporting therefore limits the ability of authors to compare outcomes and surgical techniques. Furthermore, papers often lacked detail into patient ages, demographics, length of follow up etc.

Whilst there were a number of notable exceptions to the above, authors would nevertheless advocate for future research to investigate BCA

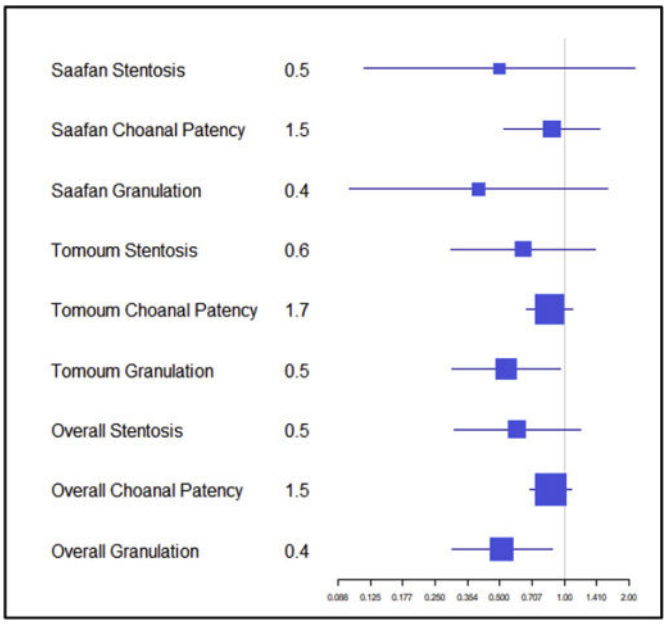

Diagram 1. RCT Forrest Plot. Risk ratio plotted, where the risk of stenosis, patency at follow-up and granulation tissue formation of stentless repair is compared to that of stented BCA repair. The only statistically significant result, where the 95% confidence interval line does not cross 1 is in relation to granulation tissue formation, indicating that there is a decreased risk of granulation tissue formation in stentless BCA repair, as compared to the use of stents.

repair using a mono-therapeutic approach, such that statistical analysis may be better performed; this would allow a greater ability to elucidate factors contributing surgical success.

Overall, it appears that stentless repair is associated with lower complication rates, particularly with regards to granulation tissue formation. Moreover, it avoids complications associated with stent dislodgement or blocking which has been variably reported in case series(16, 22).

4. Discussion

There is considerable variation in how bilateral choanal atresia (BCA) is managed amongst surgeons. The rarity of this condition, and the variation in surgical protocols makes it difficult to say with certainty whether the use of stents improves patient outcomes. We have concluded that outcomes of stenting versus stentless repair of bilateral choanal atresia are comparable. It also may be the case that complication rates are higher for patients treated with stents, particularly with respect to granulation tissue formation secondary to stent insertion.

Overall evidence for the management of bilateral choanal atresia (BCA) repair is wanting; studies are often small with multiple confounders, for example post-operative adjuncts being used in combination with stents.

In addition to stenting, a number of management options and adjuncts have been used in the treatment of BCA. These include post-operative irrigation, antibiotics, steroids, the chemotherapeutic agent mitomycin C, as well as a KTP laser. In-depth analysis of these interventions was outside the scope of this review, and we were unable to make any conclusions about adjuncts from the literature presented. A reasonable strategy for future research may be for surgeons to establish first the evidence for stents versus no stents, before optimising therapy using these adjuncts.

BCA is a rare condition, which makes generating sufficient sample sizes for study difficult. In order for high quality future data to be generated, we would advocate for a larger multicentre study to be coordinated, investigating stenting as a single variable in the repair of BCA.

5. Conclusion

This review concludes that stentless bilateral choanal atresia (BCA) repair is similarly effective to stenting and is associated with fewer complications. Further high quality studies, however, are required to confirm this. Authors recommend a future multi-centre RCT investigating a single variable, that is stents versus no stents, in the management of BCA, such that surgical outcomes of this uncommon but important condition can be optimised.

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Index Page

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2. PGCert Certificate

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17 February 2022

To whom it may concern

Dear Sir/Madam

Re: **Dr Leo Gundle**
Student number **1403527**

I was the Director of the MB ChB Programme when Leo Gundle was at the University of Bristol. I write to confirm Leo's contribution to ENT teaching across the Severn Deanery between 11th January and 17th May 2019.

Whilst in the fourth year of the MB ChB programme, Leo developed and delivered ENT revision sessions for medical students called "ENT Revision Crash Course." He did this together with some of his peers.

Leo's contribution to this initiative consisted of designing and organising a teaching program for medical students, to supplement their ENT teaching. These sessions were delivered as a series involving 12 individual teaching sessions, delivered in series' of four, at a number of hospitals including those at Taunton, Bath, Yeovil and Bristol. Topics involved practical skills such as otoscopy and tuning fork tests, as well as teaching on pathology specific to diseases of the head and neck.

Leo assisted in the development of session objectives (specifically practical skills, which students felt they needed more practice with) and delivered teaching sessions at Bath and Yeovil.

I have reviewed the formal feedback forms from Leo's sessions, and I can confirm the adequate collection of feedback from the program's participants; students overall found the sessions useful and enjoyable. I am grateful for Leo's work which benefited many students studying across several of the academies that constitute Bristol Medical School.

In summary, I can confirm Leo organised local tutors to deliver a series of teaching sessions to supplement ENT teaching on a regional level and played a leading role in designing and implementing the teaching.

Yours faithfully

Andrew Blythe

Professor Andrew Blythe, BM BCh, MA (Oxon), DRCOG, DCH, FRCGP
Professor of Medical Education & Director of Assessments for MB ChB Programme
GMC Number 3478356

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LEO GUNDLE

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gyda **RHAGORIAETH**

ar 1 Mai 2022

It is hereby certified that

LEO GUNDLE

of BANGOR UNIVERSITY

has been admitted to the degree of

POSTGRADUATE CERTIFICATE

in MEDICAL EDUCATION PRACTICE

with **DISTINCTION**

on 1 May 2022

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