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Surgical outcomes of congenital cleft palate repair in dogs: a scoping review

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Background
Congenital cleft palate (CFP) is a common orofacial malformation in dogs associated with substantial morbidity and neonatal mortality. The objective of this scoping review was to map the current veterinary literature describing surgical approaches, reported outcomes, complications, and evidence gaps following surgical repair of canine CFPs.

Methods
A scoping review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (ie, PRISMA-ScR) framework. PubMed, Web of Science, and Google Scholar were searched through January 21, 2026. Two reviewers independently screened records and charted outcomes. Eligible studies reported clinical data on surgical management of canine CFP, including oronasal fistula formation, revision surgery, or postoperative complications. "Experimental Design Grade" and "Evidence Grade" were used as descriptive critical appraisal tools. These grades were not considered formal risk-of-bias assessments.

Results
19 studies involving 122 dogs met inclusion criteria. No prospective studies were identified. Surgical approaches included von Langenbeck–type repairs, overlapping flap palatoplasty, and other mucoperiosteal or adjunctive reconstructive techniques. Oronasal fistula formation was the most commonly reported complication, ranging from 0% to 100%. Revision surgery was reported in up to 50% of cases. All included sources were classified as Experimental Design Grade III-V, and substantial heterogeneity existed in surgical techniques, outcome definitions, and follow-up duration (0.25 to 127 months). No surgical technique demonstrated consistent superiority.

Clinical Relevance
Multiple surgical techniques can achieve acceptable functional outcomes in dogs with CFPs; however, postoperative complications, particularly oronasal fistula formation, remain common. The current literature is limited by predominantly lower-level study designs and heterogeneity, highlighting the need for prospective studies with standardized outcome reporting.

Keywords: cleft palate, cleft palate repair, palatoschisis, palatoplasty, oronasal fistula

Introduction

Orofacial clefts represent the most common congenital malformation in dogs, occurring in up to 2.8% of dogs (not including malocclusions), with congenital cleft palates (CFP) accounting for up to 72% of all orofacial clefts.[1,2] These defects arise from incomplete fusion of the embryonic palatal shelves during gestation, resulting in persistent communication between the oral and nasal cavities.[2] Affected neonates experience disrupted suckling and swallowing, predisposing them to aspiration pneumonia, inadequate caloric intake, chronic nasal discharge, chronic rhinitis, and failure to thrive. Without intervention, mortality rates in canine neonates can reach 50% within the first 4 weeks of life.[3]

Clinical presentation depends on the configuration of the defect. An isolated cleft lip, for example, may cause minimal signs beyond accumulation of food debris and inflammation. Conversely, CFP and combined cleft lip and palate may often present with foamy nasal discharge during feeding, respiratory distress, and risk of fatal aspiration pneumonia. Despite these challenges, many affected dogs can typically achieve good long-term function when appropriately managed.

Etiology and breed disposition

Cleft palate etiology appears to be multifactorial, involving both genetic and environmental factors.[1] Brachycephalic dogs and other predisposed breeds (eg, Labrador Retrievers, Yorkshire Terriers,

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Bullmastiffs, and Golden Retrievers) demonstrate significantly higher risk of developing orofacial clefts.[1,4] However, due to the complex interplay of genetic susceptibility and environmental influences, clefts may present in any breed regardless of genetic predisposition. Affected animals may also present in syndromic forms, with concurrent congenital malformations, including anotia, bifid nose, bifid tongue, polydactyly, malformed tympanic bullae with middle ear disease, encephalocele, hydrocephalus, craniooschisis, microphthalmia, and limb deformities.[5–9] These abnormalities may be life-threatening and should be identified during the preoperative period.

The relative size of CFP defects changes during growth because palatal development and craniofacial growth occur at different rates. This dynamic relationship has important implications for surgical timing.[10]

Preoperative management and surgical considerations

Preoperative management focuses on maintaining adequate nutrition and minimizing aspiration risk. Strategies include assisted feeding via enteral tubes, temporary palatal prostheses, and feeding modifications until definitive surgical repair can be performed.[1,11–13]

There have been several approaches to surgical management of congenital CFP defects in dogs. The most commonly used techniques for repair of the hard palate include (1) the von Langenbeck technique (also known as the medial repositioned double flap or bilateral bipedicle flaps) and (2) the overlapping flap technique.[14,15] The von Langenbeck technique is traditionally applied for relatively narrow defects and involves bilateral releasing incisions parallel to the dental arch with medial repositioning of mucoperiosteal flaps.[6] The overlapping flap technique is generally preferred for wider defects, as it creates larger areas of connective tissue contact, positions the suture line away from the bony defect, and theoretically provides superior mechanical strength.

Currently, there are no objective guidelines that define "narrow" versus "wide" CFP defects. Technique selection ultimately depends on surgeon preference, defect configuration, and whether the defect can be closed without excessive tension.[1,16,17] More technically complex procedures have been used for defects too large for standard techniques, including buccal-based advancement flaps,[18] musculocutaneous superior labial axial pattern flaps,[19] and barrier membranes (autogenous auricular cartilage or allogenic fascia lata) placed beneath mucoperiosteal flaps.[20] Important considerations during CFP repair include preservation of the major palatine arteries, protection of the nasal mucosa at incompletely developed palatine fissures, and attainment of tension-free closure.[1,6]

Despite advances in surgical techniques and perioperative management, postoperative complications remain quite common. Oronasal fistula (ONF) formation represents the most frequent complication following CFP repair, with reported ONF rates between 50% to 100% after initial repair.[14,16] These residual defects most commonly occur at the level of the incisive papilla or at the transition between hard and soft palate, areas that are subject to increased tension and potentially compromised vascularity.[1] Multiple revision surgeries may often be required to achieve complete closure, with 1 study reporting that 33% of dogs underwent more than 1 procedure for ONF repair.[14] Risk factors for ONF formation postoperatively include previous surgical attempts, repair performed after 8 months of age, and small patient size (< 1 kg at surgery).[1,14] Although these challenges exist, the overall reported success rate for congenital hard and soft palate defect repair can be around 85% when carefully planned and executed.[14]

Study rationale and objective

Despite the clinical importance of congenital CFPs in veterinary medicine, no scoping review has yet mapped the veterinary literature using a structured, transparent, and reproducible methodology. Existing reviews are narrative in nature and rely heavily on expert interpretation rather than structured evidence appraisal.[1] This gap underscores the need for a rigorous evidence synthesis following established guidelines such as the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (ie, PRISMA-ScR) framework, which promotes comprehensive literature identification, standardized data extraction, and transparent mapping and synthesis of the available evidence. Addressing this gap may also allow clinicians to make better evidence-based decisions to standardize treatment protocols.

The objective of this scoping review was to map the extent, characteristics, surgical approaches, reported outcomes, and methodological limitations of the veterinary literature on surgical repair of naturally occurring congenital CFP in dogs.

Methods

Registration

This scoping review was not registered in a publicly accessible protocol database (eg, PROSPERO).

Inclusion and exclusion criteria

Inclusion and exclusion criteria were established a priori to define the scope of eligible evidence. Eligibility criteria included original research articles that investigated the surgical outcomes of congenital CFP repair in domestic dogs. Eligible studies were required to report a clearly described surgical treatment plan and at least 1 postoperative outcome measure (eg, ONF formation, revision surgery, functional outcome, or complication rate). Articles were excluded if not written in English, if the study does not present original clinical data and only summarizes previous reports, if follow-up period was not clearly defined, if CFP was experimentally/surgically induced, if animals were not dogs, or if the article was inaccessible.

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Literature search

A systematic search of the literature was conducted, including articles available through January 21, 2026, for articles related to surgical outcomes of congenital CFP repair in dogs. Online databases, including PubMed, Google Scholar, and Web of Science were searched for the following key terms: [(dog OR dogs OR canine) AND (cleft palate OR palatal cleft OR palatoschisis OR orofacial cleft) AND (surgery OR surgical repair OR reconstruction OR palatoplasty)]. Google Scholar was searched using simplified keyword combinations because of limitations in Boolean logic handling. The search included similar search terms related to dogs, congenital CFP, and surgical repair. Additional title-restricted searches were performed using key terms related to CFP surgery to identify highly relevant studies. Complete database-specific search strategies, search dates, and date restrictions are provided in **Supplementary Table S1**.

Titles, abstracts, and full texts were independently screened by 2 reviewers, with disagreements resolved by consensus. Articles meeting the predefined inclusion criteria were reviewed and assigned an "Experimental Design Grade" (EDG) and "Evidence Grade" (EG). Experimental Design Grade and EG were used as descriptive critical appraisal tools to characterize study design and outcome reporting and were not considered formal risk-of-bias assessments. Experimental Design Grade ranged from strongest (I) to weakest (V) study design, using a system modified from the Oxford Centre for Evidence-Based Medicine grading framework **(Table 1)**.[21] A similar EDG scale was used in Winer et al.[22] Evidence Grade ranged from strongest (A) to weakest (D), based on the type of outcome measured, according to a modified version of a previously established data quality assessment system **(Table 2)**.[23] Study identification, screening, eligibility assessment, and inclusion were documented using a PRISMA flow diagram **(Figure 1)**.[24]

Search results from PubMed, Web of Science, and Google Scholar were imported into Zotero (Corporation for Digital Scholarship) for reference management. Duplicate records were identified and removed prior to screening. Because Google Scholar records could not be exported directly, duplicate identification for these articles was performed manually.

The following data were charted from each article: the name of the first author (unless a pair of authors), publication date, the number of dogs undergoing CFP repair, the cleft type (congenital vs acquired), the median age at time of CFP repair in months with range, surgical technique or alternative method used, outcome(s) measured, range of follow-up in months, percentage with ONF, percentage with revision surgery required, complications, and funding source, if stated **(Supplementary Table S2)**.

Data synthesis

Because of substantial heterogeneity in study design, surgical techniques, outcome measures, and follow-up duration, quantitative meta-analysis was not performed. Charted data were synthesized descriptively, with emphasis on surgical technique, complication rates, ONF formation, revision surgery requirements, and reported functional outcomes.

Results

A total of 467 records were identified through database searching. After duplicate removal and screening of titles, abstracts, and full-text articles, 19 sources of evidence met the predefined inclusion criteria (Figure 1). The included studies represented 122 dogs and were published between 1974 and 2025. Study characteristics are summarized in Supplementary Table S2. The most common reasons for exclusion were duplicate records, sources of evi-

Table 1—Grading scheme used to score the quality of experimental design for manuscripts included in this scoping review.

Experimental Design Grade	Categories of cleft palate repair studies
I	Randomized, controlled, double-blinded prospective clinical trials
II	Prospective clinical trials (± control group)
III	Retrospective case series (n > 10); case–control study
IV	Retrospective case series (n < 10)
V	Single case report; expert opinion

Adapted from a grading system published by Oxford Centre for Evidence-Based Medicine (Adapted from Oxford Centre for Evidence-Based Medicine: levels of evidence (March 2009). Oxford Centre for Evidence-Based Medicine. Accessed June 6, 2026. https://www.cebm.ox.ac.uk/resources/levels-of-evidence/oxford-centre-for-evidence-based-medicine-levels-of-evidence-march-2009. ©2026 University of Oxford. Reprinted under a CC BY 4.0 license.)[21]

Table 2—Grading scheme used to score the quality of data for manuscripts included in this scoping review.

Evidence Grade[a]	Cleft palate repair outcome data characteristics
A	Histology confirming clearly defined surgical outcomes
B	Objective, clearly defined surgical outcomes (eg, documented presence or absence of oronasal fistula and/or need for revision surgery).
C	Functional or clinical outcomes reported using a defined or semiquantitative assessment (eg, categorized functional success, standardized clinical follow-up).
D	Subjective outcome reporting without defined criteria (eg, "successful repair," owner-reported improvement, or qualitative clinical assessment only).

[a]If a combination of outcome types were reported, the higher Evidence Grade was assigned (A > B > C > D).
Originally modified from a previously devised scoring system[23]

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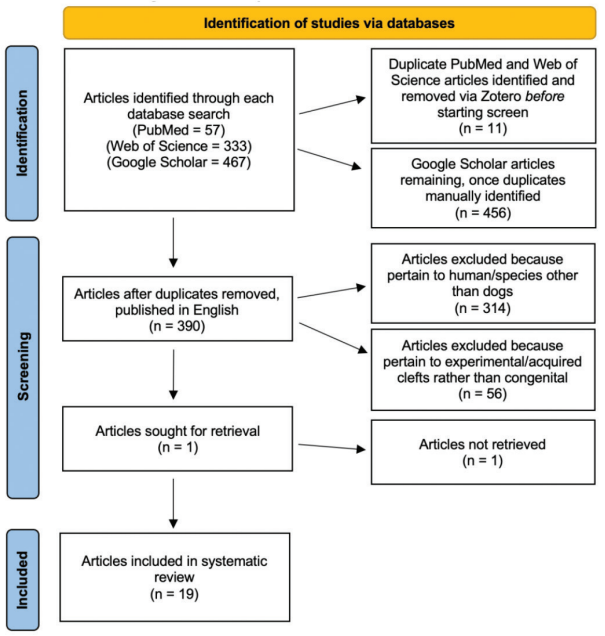


Figure 1—Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (ie, PRISMA-ScR) flow diagram showing identification, screening, eligibility assessment, and inclusion of studies in this scoping review. (Reproduced from Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi:10.1136/bmj.n71. Reprinted with permission under the Creative Commons Attribution [CC-BY 4.0].)[24]

dence involving noncanine species, and experimentally induced rather than congenital CFP models.

The included sources were predominantly lower-level study designs according to the descriptive EDG classification. No sources of evidence met criteria for EDG I or II. Four studies were classified as EDG III,[14,16,25,26] 8 studies as EDG IV,[4,18,20,27–31] and 7 studies as EDG V.[5,32–37] Most reports were retrospective case series (12 of 19 [63.2%] reports) or single-case reports (7 of 19 [36.8%] reports), and no prospective studies were identified.

All included studies evaluated surgical management of canine congenital CFP. Mucoperiosteal flap–based techniques were the predominant approach, most commonly modified von Langenbeck, overlapping flap, and medially positioned flap repairs. Several studies described procedural modifications or adjunctive interventions, including biologic scaffolds, barrier membranes, temporary palatal prostheses, staged dental extractions, bone grafts, and recombinant human bone morphogenetic protein-2. No studies evaluated medical management as a sole treatment modality.

Outcome reporting was heterogeneous. The most frequently reported outcomes were ONF formation, successful fistula closure, and the need for revision surgery, which were documented in 15 of 19 (78.9%) studies. Definitions of surgical success varied among studies, with some investigators reporting any residual communication as an ONF and others distinguishing clinically insignificant defects from clinically relevant failures.

Reported ONF rates varied substantially across studies, ranging from 0% to 100%, whereas revision surgery rates ranged from 0% to 50%. Studies with similar surgical approaches often reported markedly different outcomes. Although several reports described complete cleft closure without ONF formation, others documented persistent fistulas despite revision procedures. Follow-up duration ranged from 0.25 to 127 months, and the median age at repair reported by individual studies ranged from 1 to 14 months.

Complications included palatal dehiscence, persistent nasal discharge, chronic rhinitis, mucopurulent discharge, flap failure, and ONF formation. ONF development and the need for revision surgery were the most commonly reported adverse outcomes. However, complication reporting was inconsistent, and several studies lacked standardized outcome assessment or long-term follow-up.

Only 2 studies[32,36] incorporated histologic evaluation or tissue-level assessment. These reports demonstrated successful scaffold integration and tissue remodeling following repair, but both were limited by small sample sizes and lacked comparative clinical outcome data.

Overall, the available literature was characterized by predominantly retrospective study designs, small sample sizes, heterogeneous surgical techniques, inconsistent outcome definitions, and variable follow-up periods. These limitations precluded meaningful comparison among procedures and prevented definitive conclusions regarding the optimal surgical management of congenital CFP in dogs.

Discussion

To the authors' knowledge, this is the first scoping review mapping the current evidence of surgical outcomes following repair of congenital CFP in dogs. The current literature demonstrates that multiple surgical techniques can achieve successful closure and restoration of function; however, postoperative complications, particularly ONF formation and the need for revision surgery, remain common. Despite more than 5 decades of published experience and numerous described reconstructive approaches, the available literature does not permit robust comparison of outcomes among surgical techniques. Rather, outcomes appear to be influenced by a combination of defect severity, tissue availability, perioperative management, surgeon experience, and other patient- and procedure-specific factors.

One of the most consistent findings across the literature was the marked variability in reported outcomes. For example, Peralta et al,[14] the largest cohort included in this review, reported ONF formation in 50% of dogs and revision surgery in 46% of cases following surgical repair. In contrast, Pavletic[16] reported successful long-term closure without ONF formation or major complications following a modified von Langenbeck repair. Similar variability was observed among smaller cohort studies evaluating overlapping flap, medially positioned flap, and other

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mucoperiosteal flap-based techniques. Collectively, these findings suggest that surgical technique alone is unlikely to account for the differences in reported outcomes. Instead, successful repair appears to depend on adherence to fundamental reconstructive principles, including preservation of vascularized tissue, minimization of closure tension, and meticulous flap design.

The inability to directly compare surgical techniques is not surprising given the heterogeneity of congenital CFP defects. Cleft defect severity varied quite considerably among studies, ranging from isolated soft palate defects to extensive complete clefts involving both the hard and soft palate. Notably, Peralta et al[14] identified associations between defect severity, surgical staging, and postoperative outcomes, suggesting that defect characteristics may significantly influence success. This observation may help explain the wide variability in ONF formation and revision surgery rates reported across studies despite the use of broadly similar reconstructive techniques. These findings suggest that surgical outcomes may be influenced equally as much by the severity of the cleft as by the repair technique itself.

Although ONF formation was the most frequently reported complication, the clinical significance of residual fistulas varied among studies. For example, Castejón-González and Reiter[20] reported a dog with persistent ONF following repair that was nevertheless considered a functional success because clinical signs resolved despite incomplete anatomic closure. This observation highlights an important distinction between anatomic and functional success. While complete closure of the defect remains the ideal surgical goal, restoration of normal eating behavior, maintenance of adequate nutrition, prevention of aspiration, and overall quality of life may ultimately be more clinically relevant outcome measures. The inconsistent definitions of surgical success identified across studies likely contributed to some of the variability in reported outcomes and complicated direct comparison between techniques.

The included studies emphasize that successful management of congenital CFP also extends beyond the surgical procedure itself. Several studies incorporated specialized feeding strategies, enteral nutritional support, aspiration prevention measures, and temporary palatal prostheses.[1,4,16,30,33,35] In some reports, prosthetic devices were also used as salvage procedures following surgical complications or incomplete closure.[35] Although these interventions were inconsistently reported and rarely evaluated independently, they likely contributed to patient stabilization and postoperative recovery. Clinicians should therefore view surgical repair as 1 component of a comprehensive treatment plan that also addresses nutritional support, prevention of aspiration pneumonia, and long-term postoperative monitoring.

The findings of the present review are generally consistent with those of the recent narrative review by Castejón-González and Reiter,[1] which concluded that favorable clinical outcomes can often be achieved despite relatively high rates of postoperative ONF formation. Similarly, many studies included in the present review reported successful restoration of function following surgical repair, even when minor complications or residual fistulas were present. However, mapping of the available literature revealed substantial variability in study design, outcome assessment, follow-up duration, and overall evidence quality. Although numerous surgical techniques have been described and individual reports frequently advocated for the procedures utilized, the available literature does not support the superiority of any single approach. These findings suggest that successful outcomes can likely be achieved using multiple reconstructive techniques when applied appropriately, while also highlighting the need for higher-quality comparative studies to establish evidence-based recommendations for surgical management.

Several important sources of heterogeneity likely influenced outcomes reported across studies. These included variation in surgical technique, flap design, biomaterial use, patient age at repair, cleft severity and anatomical location, surgeon experience, study design, and duration of follow-up. Differences in defect severity and location likely contributed substantially to variability in complication and revision rates. Larger and more anatomically extensive defects likely contributed to increased reconstructive complexity and higher rates of postoperative complications. Additionally, substantial variability existed regarding timing of surgical intervention, ranging from neonatal repair to delayed reconstruction in adult dogs. The available evidence does not currently support a clearly defined optimal age for surgical intervention, suggesting that timing of repair should be individualized according to defect severity, nutritional status, aspiration risk, and patient-specific factors. Surgeon experience and procedural modification likely also contributed to heterogeneity in outcomes, as many studies described individualized techniques developed according to surgeon preference or patient-specific anatomy.

Outcome assessment varied considerably among studies and was defined using combinations of ONF presence or absence, requirement for revision surgery, resolution of clinical signs, owner-reported improvement, and subjective assessments of function. Follow-up duration also varied markedly, ranging from less than 1 month to more than 10 years. Furthermore, long-term assessment of oral function, maxillofacial growth, and quality-of-life outcomes was inconsistently reported across studies, limiting evaluation of outcomes that may be clinically more meaningful than anatomic closure alone. Collectively, these differences substantially limited comparison among surgical techniques and hindered meaningful synthesis of outcome data.

The findings of this review have several practical implications for veterinary clinicians. Because no surgical technique demonstrated consistent superiority across studies, procedure selection should be individualized based on defect characteristics, patient factors, and surgeon experience. Consideration

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should be given to cleft severity, anatomical location, tissue availability, and the potential need for staged reconstruction when developing a treatment plan. The substantial rates of ONF formation and revision surgery reported throughout the literature also highlight the importance of thorough client counseling regarding expected outcomes and potential complications. Importantly, the available evidence suggests that clinically acceptable long-term outcomes may still be achievable despite persistent small fistulae in some patients. Consequently, restoration of normal function, maintenance of adequate nutrition, and improvement in quality of life may represent more clinically meaningful measures of success than complete anatomic closure alone.

Objective tissue-level assessment (EG A) was identified in only 2 studies and represented the highest EG included in this review.[32,36] However, routine histologic evaluation following CFP repair is unlikely to be feasible in clinical patients, as collection of biopsy samples would require additional general anesthesia and could potentially disrupt the repair site or create secondary oronasal defects. Consequently, most studies relied on clinically relevant outcomes such as ONF formation, need for revision surgery, resolution of clinical signs, and restoration of oral function. Although histologic assessment may provide valuable insight into tissue integration and healing of emerging regenerative therapies, its routine use as an outcome measure in clinical studies is likely to remain limited.

This review has several strengths. A comprehensive search strategy was performed across multiple databases using predefined inclusion and exclusion criteria. Studies were descriptively appraised using established evidence grading methodologies, allowing assessment of both methodological quality and outcome reporting. Additionally, this review synthesized more than 5 decades of published literature on canine congenital CFP repair, providing a consolidated evaluation of reported surgical techniques, complications, and clinical outcomes.

Several limitations should be considered when interpreting the findings of this review. Congenital CFP is an uncommon condition in dogs, and the available literature was dominated by retrospective study designs, including retrospective case series and single-case reports. Most studies included small sample sizes and variable follow-up durations, limiting the ability to directly compare outcomes among surgical techniques. Furthermore, substantial heterogeneity in surgical approach, defect classification, timing of intervention, and outcome assessment precluded quantitative synthesis and prevented definitive conclusions regarding the superiority of any individual procedure. Publication bias may also have influenced the available evidence, as successful or novel surgical techniques are more likely to be reported than unsuccessful outcomes or routine clinical experiences. Finally, because only peer-reviewed English-language studies were included, relevant reports published in other languages or nonindexed sources may have been missed.

Additionally, the PubMed strategy used exclusionary terms to reduce irrelevant retrieval and did not include puppy- or puppies-specific terminology. Although records were also sought through Web of Science and Google Scholar, the PubMed strategy may have reduced sensitivity and could have excluded otherwise relevant reports whose titles or abstracts contained excluded terminology. These limitations should be considered when interpreting the completeness of the evidence map.

Future research should focus on improving the quality and standardization of evidence regarding congenital CFP repair in dogs. Prospective multicenter studies with larger patient populations are needed to directly compare surgical techniques and identify predictors of successful outcome. Standardized outcome measures evaluating ONF formation, revision surgery, long-term oral function, nutritional status, maxillofacial growth, and quality of life would significantly strengthen future comparative analyses. Adoption of standardized congenital CFP classification systems incorporating defect severity, anatomical location, and degree of tissue involvement may additionally improve comparison between studies. Utilization of classification systems analogous to the LAHSAL system[38] used in human cleft literature may facilitate more reproducible reporting of cleft morphology and surgical outcomes across institutions.

Emerging reconstructive and regenerative approaches also warrant further investigation. Experimental canine studies evaluating distraction osteogenesis, sutural expansion osteogenesis, biologic scaffolds, xenogeneic graft materials,[39] and microvascular reconstruction[40] have demonstrated encouraging results, although clinical translation remains limited. Similarly, several studies included in the present review evaluated adjunctive regenerative therapies, including biologic scaffolds,[32] barrier membranes,[20,27] bone grafts,[34] and recombinant human bone morphogenetic protein-2–mediated osteogenic stimulation.[25] These techniques demonstrated encouraging preliminary results but were limited by small sample sizes and lack of comparative clinical data.

Future studies are needed to determine whether regenerative and advanced reconstructive techniques can be safely incorporated into clinical management of naturally occurring congenital CFPs and whether they improve healing, reduce ONF formation, or enhance long-term functional outcomes compared with conventional flap-based reconstruction.

Successful repair of congenital CFP in dogs can be achieved using a variety of surgical techniques and adjunctive management strategies. However, no single reconstructive approach demonstrated clear superiority, and interpretation of reported outcomes is limited by the predominance of low-level evidence, small sample sizes, heterogeneous study populations, and inconsistent outcome reporting. Across studies, adherence to fundamental reconstructive principles, including tension-free closure, preservation of vascular supply, and comprehensive perioperative management, appeared more consis-

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tently associated with favorable outcomes than any specific surgical technique.

Although restoration of acceptable long-term function was frequently reported, postoperative complications, particularly ONF formation and the need for revision surgery, remained common. Additionally, several studies demonstrated that clinically acceptable outcomes may still be achieved despite small persistent fistulae, emphasizing the importance of incorporating functional outcome measures into future evaluations of surgical success.

Continued prospective investigation, standardized outcome reporting, and adoption of consistent defect classification systems are needed to facilitate meaningful comparison among techniques and establish evidence-based recommendations for management of congenital CFP in dogs.

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Supplementary Materials

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Supplementary Table S1—Database search strategies, search dates, and date restrictions for the present scoping review.

Database	Date Searched	Date Restrictions	Search Strategy
Pub Med	January 15, 2026	None	(dogs[MeSH Terms] OR dog*[Title/Abstract] OR canine*[Title/Abstract]) AND ("Cleft Palate"[MeSH Terms] OR "cleft palate"[Title/Abstract] OR "palatal cleft*"[Title/Abstract] OR palatoschisis[Title/Abstract] OR "orofacial cleft*"[Title/Abstract] OR "craniofacial cleft*"[Title/Abstract]) AND (surg*[Title/Abstract] OR repair[Title/Abstract] OR reconstruct*[Title/Abstract] OR palatoplast*[Title/Abstract] OR flap*[Title/Abstract]) AND (congenital[Title/Abstract] OR "Congenital Abnormalities"[MeSH]) NOT (humans[MeSH Terms] OR "Disease Models, Animal"[MeSH] OR acquired[Title/Abstract] OR trauma*[Title/Abstract])
Web of Science	January 18, 2026	None	(dog OR dogs OR canine) AND (cleft palate OR palatal cleft OR palatoschisis OR orofacial cleft) AND (surgery OR surgical repair OR reconstruction OR palatoplasty) Filters: Research Areas: Veterinary Sciences Document Types: Article, Review Indexes: SCI-Expanded
Google Scholar	January 21, 2026	None	(dog OR dogs OR canine) "cleft palate" surgery -human -patient -children -infant -mouse -rat -experimental -experiment -acquired

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Supplementary Table S2

Reference	Publication Year	Dogs (n)	Median Age at Time of Repair in Months (Range)	Surgical Technique	Outcome Measures	Follow-up (months)	% ONF	% Revision	% Complications	EDG	EG	Funding Source
Dall'Olio et al.	2024	1	3	Decellularized skin scaffold	Graft integration; scar formation	24	0/1 (0%)	0/1 (0%)	0	V	A	The São Paulo Research Foundation
Castejón-González and Reiter	2023	7	5 (4-9)	Von Langenbeck technique or 2-flap palatoplasty and barrier membrane	ONF closure; clinical outc	1-30	28.6% (2/7); functional successes (small residual ONF, no clinical signs)	1/7 (14.3%)	14.3% (1/7): Soft palate dehiscence + chronic rhinitis (managed medically and surgically); shrinkage/folding of ear due to lack of auricular cartilage	IV	B	None stated
Haggerty et al.	2024	4	9 (8-11)	Medially positioned single mucoperiosteal flap ± allograft membrane	Semi-quantitative scoring system of gross appearance of palate and a variety of other clinical signs	1-36	Small, clinically insignificant ONF: 3/4 (75%) Large persistent ONF (clinical signs): 1/4 (25%)	1/4 (25%)	4/4 (100%): Palatal dehiscence (all cases, varying severity); Minor intraoperative flap perforation (case 2); Small persistent defects left untreated (cases 1, 3, 4)	IV	B	None stated
Davidson et al.	2014	1	14	Sliding bipedicle mucoperiosteal flap	ONF closure; revision surg	18	0/1 (0%)	0/1 (0%)	0/1 (0%)	V	B	None stated
White et al.	2009	6	7.5 (2.3–17)	Three-layer appositional repair or nasal pharyngael mucosal flap	Clinical outcome; dietary f	7-27	3/6 (50%); dehiscence	1/6 (17%)	Palatal dehiscence 3/6 (50%); antibiotic responsive mucopurulent discharge 1/6 (17%)	IV	B	None stated
Ishikawa et al.	1994	1	6	Single-pedicled mucoperiosteal flaps (Veau-Wardill-Kilner technique) + cortico-cancellous bone graft	ONF persistence; function	72	1/1 (100%): functional, lack clinical signs	0/1 (0%)	0/1 (0%)	V	B	None stated
Peralta et al.	2015	4	9 (8–36)	Staged selective dental extractions followed by double-layer mucosal flap closure	ONF closure; postoperativ	3-48	1/4 (25%)	1/4 (25%)	1/4 (25%): persistent pinpoint defects	IV	B	None stated
Warzee et al.	2001	5	10 (5–11)	Two-layer soft palate closure with absorbable suture	Clinical outcome; oral exa	1-127	0/5 (0%)	0/5 (0%)	1/5 (20%)	IV	B	None stated
Arzi and Verstraete	2011	1	12	Bifid nose repair + one-layer primary cleft palate repair	Palatal healing; clinical ou	6	0/1 (0%)	0/1 (0%)	0/1 (0%)	V	B	None stated
Lee et al.	2006	1	3	Mucoperiosteal and overlapping flap technique, followed by temporary palatal prosthesis	Clinical outcome	30	1/1 (100%); functional	1/1 (100%); one revision surgery that failed; third surgery was palatal prosthesis	1/1 (100%); Postoperative dehiscence after first surgery Failure of second surgery (buccal mucosal flap failure) Residual oronasal fistula after third surgery (small but persistent)	V	B	None stated
Xavier et al.	2025	9	4	Medially positioned flap repair (double-layer soft palate closure); clinical management prior to surgery	Surgical survival; palatal h	3	0/9 (0%)	3/9 (33%)	0/9 (0%)	IV	B	None received
Pavletic	2023	12	9.5 (5–46.8)	Modified von Langenbeck technique using bilateral bipedicle mucoperiosteal flaps	Palatal closure; functional	0.5-91	0/12 (0%)	0/12 (0%)	1/12 (8%); minor rostral dehiscence without clinical effect	III	B	None received
Martínez-Álvarez et al.	2013	15 (4 control, 6 two-flap palatoplasty, 5 injection/adhesion)	**Surgery Alone (6)**: 2.3; **Injection + Surgery (5)**: 2.3	**Injection/adhesion:** subperiosteal injection of rhBMP-2 in HA-based hydrogel at 6 wk → direct midline closure at 10 wk; **Surgery Alone**: traditional two-flap palatoplasty	Bone formation (CT); pala	3.5–4.5	**Injection group:** small anterior fistulas reported in early cases (exact number not specified)	0/15 (0%)	**Injection**: minor anterior fistulas early; **Surgery**: palatal bone defects, nasal vault narrowing, bone overlap/bending	III	B	Grants from Spanish Ministry of Science and Innovation (PS09/01762), Osteology Foundation (09-012), and University ComplutenseBanco Santander to the Complutense Research Group 920202
Peralta et al.	2018	26	9.1 (3.5–21)***	**Hard palate:** VLB, BPF, OLF; **Soft palate**: direct closure (2- or 3-layer); staged vs unstaged approaches	Functional outcome; ONF	0.5-24	13/26 (50%)	46% overall (12/26); 92% of ONF cases (12/13)	50% (ONF formation; primary reported complication)	III	B	None stated
Tolwani et al.	2004	1	1	von Langenbeck-type procedure	Functional outcome; skull	4	0/1 (0%)	0/1 (0%); euthanized at 6 months.	0/1 (0%)	V	A	National Institute of Neurological Disorders and Stroke
Howard et al.	1974	15	2.5 (1.6-18)***	von Langenbeck (12), mucoperiosteal flap (3)	Clinical outcome; dehisce	5-66	NR	NR (6 minimum had previously undergone surgery	4/12 **[van Langenbeck]**: died due to persistent clinical signs associated with failure of cleft closure; 1/3 [**mucoperiosteal**]: dehisced in anterior aspect	III	B	None stated
Locatelli et al.	2025	1	4	Bipedicle flap sliding technique (hard palate) + continuous double-layer (soft palate)	Palatal healing; weight ga	0.25	0/1 (0%)	0/1 (0%)	0/1 (0%); none reported	V	D	None stated
Griffiths and Sullivan	2001	9	4 (1-9)	Bilateral overlapping mucosal single-pedicle flaps	Clinical outcome; palatal h	2-12	0/9 (0%)	0/9 (0%)	1/9 (11%); persistent nasal discharge	IV	C	None stated
Sager and Nefen	1998	3	5 (5-10)	Bilateral buccal mucosal flaps	Palatal closure; dehiscenc	18-36	0/3 (0%)	1/3 (33%)	1/3 (33%); Partial dehiscence with continued intermittent discharge post-revision surgery	IV	B	None stated

*Mean age at time of repair

*Persistent ONF was clinically insignificant.

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