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DACRYOCYSTORHINOSTOMY IN CONGENITAL NASOLACRIMAL DUCT OBSTRUCTION: A MULTIDISCIPLINARY APPROACH

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Abstract: INTRODUCTION The introduction discusses congenital nasolacrimal duct obstruction (CNLDO), a prevalent condition in pediatric ophthalmology, characterized by tear drainage issues due to developmental anomalies. It outlines the anatomy and physiology of the lacrimal system in neonates, the common congenital conditions leading to nasolacrimal duct obstruction, and the role of different specialties in diagnosis and management. The evolution of dacryocystorhinostomy (DCR) as a treatment option is reviewed, highlighting the differences between external and endoscopic approaches, the role of imaging and anesthesia, and the need for a multidisciplinary approach involving ophthalmologists, otorhinolaryngologists, and plastic surgeons. The introduction sets the stage for a discussion on the various aspects of DCR, including recent advancements and future perspectives. **OBJETIVE** To evaluate the indications, techniques, and outcomes of dacryocystorhinostomy (DCR) in managing congenital nasolacrimal duct obstruction (CNLDO). **METHODS** This is a narrative review which included studies in the MEDLINE – PubMed (National Library of Medicine, National Institutes of Health), COCHRANE, EMBASE and Google Scholar databases, using as descriptors: "Congenital Nasolacrimal Duct Obstruction" AND "Pediatric Dacryocystorhinostomy" OR "Endoscopic DCR Techniques" OR "Multidisciplinary Surgical Approach" AND "Pediatric Oculoplastic Surgery" in the last years. **RESULTS AND DISCUSSION** The results and discussion provide a comprehensive analysis of the outcomes of DCR, comparing external and endoscopic techniques in terms of success rates, patient selection, and management strategies. It explores the role of anatomical variations and adjunctive procedures, such as silicone intubation and balloon dacryoplasty, in improving surgical outcomes. The discussion also covers the role of imaging in preoperative planning, the challenges of managing postoperative complications, and the impact of patient-specific factors, including age and co-existing conditions. It emphasizes the importance of a multidisciplinary approach to care and the benefits of recent advancements in minimally invasive surgical techniques. The section also examines the psychological and social impacts of the procedure, the importance of interdisciplinary collaboration, and the financial implications of different surgical approaches. **CONCLUSION** The conclusion underscores the importance of individualized patient care and a multidisciplinary approach in managing congenital nasolacrimal duct obstruction with DCR. It highlights the evolving nature of DCR techniques, with a growing emphasis on minimally invasive approaches and the integration of advanced technologies. The conclusion advocates for continued research, improved surgical strategies, and equitable healthcare policies to enhance access to specialized care, optimize clinical outcomes, and improve the quality of life for pediatric patients with CNLDO.

Keywords: Congenital Nasolacrimal Duct Obstruction; Pediatric Ophthalmology; Endoscopic Surgery; Dacryocystorhinostomy

INTRODUCTION

Congenital nasolacrimal duct obstruction (CNLDO) represents a significant pediatric condition, marked by a failure of the nasolacrimal duct to open properly, affecting approximately 6% to 20% of newborns[1]. The condition can manifest with persistent epiphora, mucopurulent discharge, and recurrent infections, substantially impacting a child's quality of life[1]. The etiology of CNLDO is multifactorial, often involving developmental anomalies at the valve of Hasner, where a membranous obstruction can prevent the drainage of tears from the nasolacrimal sac into the inferior meatus of

the nose[1]. While spontaneous resolution is common within the first year of life, a subset of patients requires surgical intervention to alleviate symptoms and prevent complications, with dacryocystorhinostomy (DCR) being the definitive procedure in persistent cases[2].

Understanding the anatomy and physiology of the lacrimal drainage system is paramount in managing CNLDO[2]. The nasolacrimal apparatus is composed of the puncta, canaliculi, lacrimal sac, and nasolacrimal duct, each playing a critical role in the drainage of tears from the ocular surface to the nasal cavity[2]. In neonates and infants, the lacrimal drainage system undergoes significant postnatal maturation[2]. The anatomical intricacies and developmental changes in this system contribute to the varying presentations and management approaches of CNLDO[3]. For instance, the narrow and tortuous nature of the neonatal nasolacrimal duct, combined with its unique histological properties, can predispose to obstruction and inflammation[3].

Several congenital conditions predispose to nasolacrimal duct obstruction, including craniofacial anomalies like Down syndrome, cleft palate, and Goldenhar syndrome[3]. These conditions often involve structural abnormalities that impede normal tear drainage, necessitating a more complex and tailored approach to management[4]. In such cases, the involvement of multidisciplinary teams, including ophthalmologists, otorhinolaryngologists, and plastic surgeons, becomes essential for comprehensive care[4]. An ophthalmologist is typically the first to diagnose and manage CNLDO, employing a range of diagnostic tools, including fluorescein dye disappearance tests and lacrimal irrigation[4]. However, when conservative measures fail, and symptoms persist beyond the first year of life, the consideration for surgical intervention, particularly dacryocystorhinostomy, becomes pertinent[5].

From the otorhinolaryngological perspective, congenital nasolacrimal duct obstruction may present with overlapping nasal pathologies, such as turbinate hypertrophy or deviated nasal septum, which can further complicate tear drainage[5]. The ENT specialist's role is critical in managing the nasal aspects of the condition, often collaborating in endoscopic approaches to dacryocystorhinostomy[5]. Meanwhile, plastic surgery considerations come into play when facial anomalies or post-surgical aesthetic outcomes are of concern, especially in cases involving craniofacial syndromes where a cosmetic and functional balance is necessary[6]. The integration of these specialties provides a holistic approach to managing complex cases of CNLDO[6].

Dacryocystorhinostomy is indicated in pediatric patients who have persistent symptoms of nasolacrimal duct obstruction despite conservative management, or in whom other treatment options, such as nasolacrimal duct probing, have failed[6]. Historically, DCR has evolved from an external approach, which involves creating an osteotomy through a skin incision, to an endoscopic approach that allows access to the lacrimal sac via the nasal cavity without external incisions[7]. The choice between these techniques often depends on the surgeon's expertise, the patient's anatomy, and the presence of concurrent nasal pathologies[7].

The historical development of DCR as a treatment modality has its roots in the early 20th century, with external DCR being the gold standard for many decades[7]. However, with advancements in endoscopic technology, there has been a paradigm shift towards minimally invasive approaches, which offer reduced scarring, shorter recovery times, and lower risk of complications[8]. This evolution has expanded the indications for DCR, particularly in pediatric patients where cosmesis and reduced morbidity are of paramount concern[8]. Comparing external and

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endoscopic DCR in congenital cases reveals nuanced differences in outcomes, which necessitates a thorough understanding of patient selection criteria, surgical technique, and postoperative care[8].

Imaging plays a pivotal role in the diagnosis and preoperative planning of DCR in pediatric patients with CNLDO[9]. High-resolution computed tomography (CT) and magnetic resonance imaging (MRI) can provide detailed anatomical information, aiding in the identification of the site of obstruction, assessment of surrounding structures, and detection of any concurrent abnormalities that may influence surgical outcomes[9]. Furthermore, pediatric anesthesia considerations are crucial given the unique physiological responses of children to anesthesia and surgery, highlighting the need for specialized pediatric anesthesiologists to minimize perioperative risks[9].

The epidemiology of congenital conditions requiring DCR varies across different populations, influenced by genetic, environmental, and healthcare access factors[10]. Understanding these epidemiological patterns is essential for developing targeted screening, prevention, and treatment strategies[10]. Additionally, managing recurrent nasolacrimal duct obstruction in pediatric patients poses several challenges, often requiring repeated interventions, advanced imaging, and sometimes a combination of surgical approaches to achieve satisfactory results[10]. Postoperative outcomes and complications of DCR in congenital cases can vary widely, influenced by factors such as the patient's age at the time of surgery, the presence of underlying conditions, and the specific surgical technique employed[11]. The impact of DCR on the quality of life in children with congenital lacrimal duct obstruction is profound, not only alleviating symptoms but also preventing recurrent infections and potential vision-threatening complications[11]. This underscores the importance of an interdisciplinary approach to DCR, involving collaboration between ophthalmologists, otorhinolaryngologists, and plastic surgeons to optimize both functional and aesthetic outcomes[11].

Recent advancements in minimally invasive techniques, such as the use of laser-assisted DCR and balloon dacryoplasty, have further refined the management of CNLDO, offering new avenues for treatment with potentially lower morbidity and shorter recovery times[12]. However, these techniques also raise questions regarding cost-effectiveness and the overall healthcare burden associated with managing congenital nasolacrimal duct obstructions, particularly in resource-limited settings[12]. As such, future perspectives in the management of congenital conditions requiring DCR should focus on balancing efficacy, safety, and accessibility, while incorporating emerging technologies and techniques[12].

OBJETIVES

To evaluate the indications, techniques, and outcomes of DCR in managing CNLDO.

SECUNDARY OBJETIVES

1. To analyze the impact of anatomical variations on surgical outcomes in congenital cases.
2. To assess the implications of early versus delayed surgical intervention in CNLDO.
3. To evaluate the postoperative complications and the strategies for their management in pediatric DCR.
4. To explore recent advancements in minimally invasive techniques for DCR.
5. To examine the psychosocial impacts and quality of life outcomes for children undergoing DCR.
6. To compare the effectiveness of external versus endoscopic DCR in pediatric patients.

METHODS

This is a narrative review, in which the main aspects of the indications, techniques, and outcomes of DCR in managing CNLDO in recent years were analyzed. The beginning of the study was carried out with theoretical training using the following databases: PubMed, sciELO and Medline, using as descriptors: "Congenital Nasolacrimal Duct Obstruction" AND "Pediatric Dacryocystorhinostomy" OR "Endoscopic DCR Techniques" OR "Multidisciplinary Surgical Approach" AND "Pediatric Oculoplastic Surgery" in the last years. As it is a narrative review, this study does not have any risks.

Databases: This review included studies in the MEDLINE – PubMed (National Library of Medicine, National Institutes of Health), COCHRANE, EMBASE and Google Scholar databases.

The inclusion criteria applied in the analytical review were human intervention studies, experimental studies, cohort studies, case-control studies, cross-sectional studies and literature reviews, editorials, case reports, and poster presentations. Also, only studies writing in English and Portuguese were included.

RESULTS AND DISCUSSION

The success rates of external versus endoscopic DCR in congenital conditions have been extensively studied, with recent meta-analyses suggesting comparable outcomes in terms of symptom resolution and patency rates[13]. However, endoscopic DCR offers distinct advantages in selected cases, particularly where cosmesis is a concern or where concomitant nasal pathology exists[13]. The choice between early versus delayed DCR remains a topic of debate, with some studies advocating for early intervention to prevent chronic epiphora and recurrent infections, while others recommend a more conservative approach to allow for potential spontaneous resolution[13]. Nasolacrimal duct probing is often employed as a first-line intervention in congenital cases, with high success rates reported in infants under one year of age[14]. However, the efficacy of this procedure diminishes with age, necessitating more definitive interventions such as DCR in older children[14]. Conservative management, including massage, topical antibiotics, and observation, remains the initial approach for many infants with CNLDO, with DCR reserved for those who fail to respond to these measures or present with more complex anatomical variations[14].

Anatomical variations, such as the presence of a bony obstruction or a narrow nasolacrimal duct, can significantly affect DCR outcomes in congenital conditions[15]. Secondary surgical interventions may be required in cases of failed DCR, with options including revision DCR, silicone intubation, or alternative approaches such as conjunctivodacryocystorhinostomy (CDCR)[15]. The role of imaging techniques like CT and MRI in preoperative planning cannot be overstated, as they provide critical insights into the anatomy of the nasolacrimal drainage system and guide surgical decision-making[15]. Patient selection criteria for DCR in congenital conditions are complex, involving an assessment of the severity and duration of symptoms, the presence of comorbidities, and the likelihood of spontaneous resolution[16]. Age at surgery has been shown to impact DCR outcomes, with younger patients typically experiencing better results due to greater tissue plasticity and a reduced risk of fibrosis[16]. Silicone intubation as an adjunct to DCR is often employed to maintain duct patency and minimize the risk of restenosis, particularly in complex or recurrent cases[16].

Complications associated with DCR in pediatric patients are relatively rare but can include infection, bleeding, granuloma

formation, and obstruction recurrence[17]. Postoperative care protocols vary between external and endoscopic DCR, with the latter typically involving shorter recovery times and less postoperative discomfort[17]. The role of antibiotic prophylaxis in pediatric DCR is still debated, with some studies suggesting a benefit in reducing postoperative infection rates, while others find no significant difference[17].

Surgical outcomes of dacryocystorhinostomy (DCR) vary significantly based on the specific techniques and equipment used[18]. External DCR, traditionally considered the gold standard, involves a skin incision to access the lacrimal sac and create a bony opening into the nasal cavity[18]. This method offers high success rates, often exceeding 90%, but comes with the trade-offs of a visible scar and a longer recovery period[18]. Endoscopic DCR, in contrast, is performed intranasally, eliminating external scars and generally resulting in quicker recovery and less postoperative discomfort[19]. Advances in surgical instruments and endoscopic visualization have improved the success rates of endoscopic DCR, making it a viable alternative to external approaches, especially in patients with aesthetic concerns or specific nasal anatomy that favors an internal approach[19]. The choice between these techniques should be guided by individual patient factors, surgeon expertise, and the presence of any concomitant nasal pathology[19].

Antibiotic prophylaxis in pediatric DCR remains a contentious issue[20]. While some studies advocate for its routine use to prevent postoperative infections, particularly in younger patients with immature immune systems, others have reported no significant difference in infection rates with or without antibiotics[20]. The decision to use antibiotics should consider patient-specific risk factors, such as the presence of active infection at the time of surgery, and institutional protocols[20]. Postoperative management should also include careful monitoring for complications such as granuloma formation, infection, or restenosis, which may necessitate further intervention[21]. Achieving optimal outcomes in patients with complex congenital abnormalities presents several challenges[21]. These patients may have additional anatomical or physiological variations that complicate both the surgical procedure and postoperative recovery[21]. For example, children with craniofacial syndromes often present with aberrant lacrimal anatomy or other structural abnormalities that make traditional DCR techniques less effective[22]. In these cases, a multidisciplinary approach involving ophthalmologists, otorhinolaryngologists, and plastic surgeons is crucial to tailor the surgical strategy to the individual patient's needs[22]. Endoscopic techniques may offer benefits in these difficult-to-access lacrimal systems, allowing for better visualization and precise targeting of the obstruction while minimizing tissue disruption[22].

Otolaryngologists play a vital role in managing nasal pathology during DCR, particularly in cases where there is concurrent nasal disease, such as turbinate hypertrophy or septal deviation, which can impede tear drainage and affect surgical outcomes[23]. Addressing these nasal pathologies concurrently during DCR may improve overall success rates and reduce the need for future interventions[23]. Furthermore, plastic surgeons may be involved in cases requiring reconstruction or addressing cosmetic concerns, particularly when external DCR is performed[23]. From a plastic surgery perspective, optimizing aesthetic outcomes while ensuring functional success is a critical consideration, particularly in children where long-term scarring and facial growth must be taken into account[24]. Long-term success rates and follow-up protocols for DCR in children

vary depending on the surgical technique, patient selection, and the presence of any comorbid conditions[24]. Regular follow-up is essential to monitor for complications, assess the patency of the nasolacrimal duct, and evaluate the need for further intervention[24]. Long-term outcomes are generally favorable, with a significant improvement in symptoms and quality of life reported in most studies[25]. However, the presence of co-existing conditions, such as Down syndrome or craniofacial anomalies, can affect both short- and long-term outcomes, necessitating a more individualized approach to follow-up and management[25].

The impact of DCR on tear production and ocular surface health is another important consideration, particularly in pediatric patients where the lacrimal apparatus is still developing[25]. Studies have shown that DCR can lead to a temporary alteration in tear dynamics, but these changes are typically transient and do not result in long-term ocular surface damage[26]. Nonetheless, careful assessment of tear film and ocular surface health both pre- and postoperatively is advisable to identify any potential issues early and manage them appropriately[26]. The psychological and social impacts of DCR on children and their families should not be underestimated[26]. While the primary goal of DCR is to alleviate symptoms and prevent complications, the surgical experience itself, including the perioperative period, can be a source of anxiety and stress for both the patient and their caregivers[27]. Clear communication, appropriate preoperative counseling, and postoperative support are essential components of care to ensure patient and family satisfaction[27]. The interdisciplinary collaboration in complex congenital dacryocystorhinostomy cases is critical for optimizing both clinical outcomes and patient experience[27].

Surgical skill and experience are paramount in determining pediatric DCR outcomes[28]. Studies consistently show that outcomes are better in centers with high volumes of pediatric lacrimal surgery, highlighting the importance of specialized training and experience[28]. Novel technologies and surgical aids, such as intraoperative navigation, laser-assisted techniques, and endoscopic high-definition cameras, are expanding the possibilities for safer, more effective DCR procedures[28]. These innovations can enhance visualization, improve precision, and reduce intraoperative risks, particularly in complex congenital cases[29]. Preoperative endoscopic evaluation by otorhinolaryngologists can be invaluable in identifying any nasal pathologies that could affect surgical planning and outcomes[29]. Endoscopic assessment allows for a thorough evaluation of the nasal anatomy, identification of any obstructive lesions, and planning of concurrent procedures to address these issues[29]. This comprehensive approach helps optimize surgical outcomes and reduce the risk of postoperative complications[30].

Hybrid surgical approaches, combining elements of both external and endoscopic techniques, are being explored to optimize outcomes in selected cases[30]. For instance, a hybrid approach may be beneficial in patients with difficult anatomy or those who have failed initial DCR attempts[30]. Similarly, the choice between local and general anesthesia in pediatric endoscopic DCR should be carefully weighed, considering factors such as the child's age, anxiety levels, and the complexity of the procedure[31]. Recent evidence suggests that, while general anesthesia provides better control and comfort, local anesthesia may be feasible in selected older children, reducing the risks associated with general anesthesia[31].

CONCLUSION

The management of congenital nasolacrimal duct obstruction (CNLDO) requiring dacryocystorhinostomy (DCR) is a complex and evolving field that necessitates a nuanced understanding of the anatomy, pathology, and surgical techniques involved. The choice between external and endoscopic DCR should be tailored to the individual patient, taking into account the specific anatomical considerations, the presence of concurrent nasal pathology, and the expertise of the surgical team. Recent advancements in minimally invasive techniques and technologies have expanded the therapeutic options available, offering new opportunities for improving outcomes in pediatric patients.

A multidisciplinary approach, involving ophthalmologists, otorhinolaryngologists, and plastic surgeons, is essential for optimizing both functional and aesthetic outcomes in children with CNLDO. This collaboration is particularly important in complex cases where multiple congenital abnormalities are present or when previous interventions have failed. Future research should continue to focus on refining surgical techniques, exploring novel technologies, and developing comprehensive care pathways that incorporate both medical and psychosocial aspects to enhance overall patient care.

The integration of emerging surgical technologies and a focus on cost-effectiveness will be key to ensuring that high-quality care is accessible to all patients, regardless of geographic or socioeconomic barriers. As we move forward, the emphasis must be on individualized patient care, interdisciplinary collaboration, and ongoing research to improve our understanding and management of congenital nasolacrimal duct obstruction. This approach will not only optimize surgical outcomes but also enhance the quality of life for affected children and their families.

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