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Original Research

Effectiveness of non-surgical intervention in resolving congenital nasolacrimal duct obstruction

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Abstract

Congenital nasolacrimal duct obstruction (CNLDO) affects 6–20% of children. This condition results from a blockage or incomplete opening of the nasolacrimal duct, which drains tears into the nasal cavity. If untreated, CNLDO can lead to chronic tearing, eye discharge, and an increased risk of eye infections. This study aims to assess the effectiveness of crigler massage in children's CNLDO. The study was conducted at the Eye Care Unit of Bangrilla Community Hospital, Mirpur, Azad Jammu and Kashmir (AJ&K), from November 2022 to December 2023. A total of 130 children under one year of age presenting with persistent tearing (epiphora) due to unilateral or bilateral nasolacrimal duct obstruction were included. Parents were instructed to perform Crigler massage, a conservative, non-surgical technique involving lacrimal sac massage, for three months. The efficacy of this treatment was monitored over the course of the study. The participants included 73 children (56.2%) aged 0–6 months and 57 children (43.8%) aged 6–12 months. Male participants constituted 43.8% of the total number, while the female participants accounted for the remaining 56.2%. CNLDO cases involved unilateral eye obstruction, with 30.8% affecting the right eye and 35.4% affecting the left eye, while 33.8% demonstrated bilateral involvement. By the end of the three months, 92.3% of children had achieved complete resolution of symptoms. Seven children (5.4%) did not respond to the Crigler massage and required surgical probing, while three (2.3%) failed to complete follow-up. Crigler massage proved to be an effective, non-invasive treatment for CNLDO in children, achieving a high success rate when performed consistently and correctly.

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Introduction: The lacrimal system is a complex anatomical structure responsible for tear production, distribution, and drainage, playing a crucial role in ocular surface health. This system comprises the primary and secondary lacrimal glands, their secretions, and the lacrimal duct [1]. Understanding its anatomy is essential for comprehending the pathophysiology of tear drainage disorders in pediatric patients. The lacrimal drainage system is anatomically divided into proximal and distal segments of the excretory pathway. The proximal portion includes the punctum, canaliculus, and common canaliculus, whereas the distal portion contains the lacrimal sac and nasolacrimal duct. The nasolacrimal duct terminates beneath the inferior turbinate, emptying into the inferior meatus, as illustrated in Figure 1 [2]. This anatomical pathway is significant in explaining the causes of obstruction and differentiating between congenital and acquired conditions. Congenital nasolacrimal duct obstruction (CNLDO) represents one of the most prevalent ophthalmologic conditions in newborns, affecting approximately 6% to 20% of infants. During the first year of life, 90% of spontaneous resolutions have been reported [3,4]. This condition occurs due to an anatomical obstruction of the nasolacrimal drainage system, most commonly because of membrane blockage at the valve of Hasner or incomplete canalization of the distal nasolacrimal duct. This leads to symptoms like epiphora (excessive tearing) and dacryocystitis (inflammation of the tear sac) [5]. If left untreated, complications may include chronic conjunctivitis and, rarely, pre-septal cellulitis [6]. Fortunately, CNLDO usually resolves spontaneously as the nasolacrimal duct lengthens and increases in volume during the first year of life, with spontaneous resolution rates reported in up to 90% of cases [7]. Conservative therapy, particularly lacrimal sac massage using techniques such as the Crigler method, combined with topical antibiotics when indicated, represents the first-line management approach for infants under one year of age [8]. Lacrimal massage has demonstrated remarkable efficacy, with studies reporting success rates of up to 94.7% [9].

The Crigler massage technique involves using the index finger to apply pressure over the common duct, followed by downward stroking to avoid backflow through the puncta, as shown in Figure 2. The recommended protocol consists of 15 strokes performed three times daily. This technique increases the hydrostatic pressure within the lacrimal sac, which eventually overcomes the blockage of the membrane [4]. The elevated pressure within the sac also helps prevent microbial invasion and reduces infection risk. Patients typically become accustomed to this massage after repeated sessions, with decreased crying and improved tolerance [6,10]. In cases where conservative management fails or in patients with chronic or recurrent bacterial conjunctivitis, more invasive procedures such as probing, balloon catheter dilation, or dacryocystorhinostomy may be recommended. However, it has been shown that the success rate of probing decreases with increasing age, highlighting the importance of early conservative treatment [11]. Therefore, the objective of this study is to assess the efficacy of hydrostatic lacrimal massage as a first-line, non-invasive treatment option for CNLDO in infants by analyzing its success rates and demographic factors. By evaluating its outcomes and comparing them with existing literature on both conservative and invasive treatments, this study seeks to highlight the efficacy, safety, and compliance of Crigler massage, supporting its role as a practical and non-invasive therapeutic option for the early management of CNLDO.

Material and Methods

Study Design and Setting: From November 2022 to December 2023, a prospective observational study was conducted in the Eye Care Unit of Bangrilla Community Hospital, Mirpur, AJ&K, to evaluate the effectiveness of non-surgical Crigler massage as a conservative management for nasolacrimal duct obstruction in infants younger than one year.

Diagnostic Criteria: The diagnosis of CNLDO was established based on clinical presentation of persistent epiphora (excessive tearing) in the absence of active conjunctivitis or other ocular surface disorders. All patients underwent a comprehensive ophthalmological examination, including slit-lamp bio-microscopy when feasible. The fluorescein disappearance test (FDT), an outpatient procedure, was used in cases of doubtful unilaterality. In situations where massage or topical treatment failed to remove the obstruction, these patients underwent Crigler massage with pressure irrigation (PI) for definitive diagnosis.

Inclusion Criteria: The study comprised 130 children under the age of one who had epiphoria with no sex-based or genetic restrictions.

Exclusion criteria: Exclusion criteria included patients with excessive tearing due to reflex tearing secondary to conjunctivitis (diagnosed by slit-lamp examination and clinical assessment), intraocular inflammation, endophthalmitis, entropion or ectropion, and congenital glaucoma, all diagnosed by slit lamp examination and intraocular pressure measurement when indicated.

Study Protocol: A structured proforma was used to systematically record patient information, clinical presentation, and follow-up data. Each patient underwent a detailed clinical examination with assessment of epiphora and an eye closure test to confirm the diagnosis. Parental consent was obtained, and sufficient time was allocated for follow-up. All parents received detailed instructions and hands-on training regarding the proper technique for applying hydrostatic pressure on the lacrimal sac using the conservative, non-surgical Crigler massage method. Parents were told to perform the massage 10–15 times a day and to apply topical tobramycin drops four times daily. Antibiotic ointment was recommended when

mucopurulent discharge was present or as a preventive measure against secondary infection.

Follow-up examinations to evaluate treatment outcomes were performed at 1, 2, and 3 months after initiation of treatment, with final assessment conducted at the end of the study period.

Statistical analysis: Descriptive statistics were used to analyze patient demographics and treatment outcomes. Qualitative data were presented as frequencies and percentages and displayed graphically for visual representation. Statistical analysis was performed using SPSS version 27.0.1. Chi-square tests were employed for categorical variables where appropriate

Results: This study included 130 patients in total. Of these, 73 children (56.2%) were between the ages of 0 to 6 months, and 57 children (43.8%) were between the ages of 6 to 12 months. Male participants constituted 43.8% (n=57) of the total, while female participants accounted for 56.2% (n=73). Among the participants, 66.2% (n=86) presented with unilateral involvement, with 30.8% (n=40) affecting the right eye and 35.4% (n=46) affecting the left eye. Additionally, 33.8% (n=44) demonstrated bilateral involvement, as shown in Table 1. All children diagnosed with congenital nasolacrimal duct obstruction received Crigler massage as the primary treatment, with topical antibiotic therapy prescribed for a period of one to two weeks as indicated.

Follow-up evaluations were conducted at the end of 1–3 months of treatment. After the 3-month treatment period, 92.3% (n=120) of patients achieved complete resolution of symptoms. Only 5.4% (n=7) of children did not benefit from Crigler massage and were referred for nasolacrimal duct probing. Three patients (2.3%, n=3) were lost to complete follow-up, of whom two patients (1.5%, n=2) had bilateral congenital nasolacrimal duct obstruction and one patient (0.8%, n=1) had unilateral obstruction.

Comparative analysis using the Chi-square test revealed no statistically significant association between treatment success and age group ($p = 0.650$), gender ($p = 0.542$), or type of eye involvement ($p = 0.408$). These findings are illustrated in Figure 3, which depicts the distribution of treatment effectiveness, non-effectiveness, and loss to follow-up.

Discussion: The Crigler massage technique for conservative treatment of CNLDO has emerged as the initial and gold standard approach, effectively avoiding intervention-related complications while achieving excellent clinical outcomes. This non-invasive method has consistently demonstrated its effectiveness as the primary conservative treatment for CNLDO, helping to prevent complications associated with more invasive interventions. Treatment success is primarily influenced by several key factors, including patient age at initiation, proper massage technique, parental compliance, and presence of concurrent comorbidities related to nasolacrimal duct obstruction.

The nasolacrimal apparatus canalization is often finished during embryonic development before birth. However, up to 70% of babies at the level valve of Hasner experience membrane obstruction at the lower end of the duct 12. Conservative therapy with lacrimal sac massage is the first choice for newly diagnosed cases of CLDO. According to the literature, the effectiveness of Crigler massage ranges from 82.9% to 94.7% 8. Referring the child to an ophthalmologist for a thorough eye exam is advised; nevertheless, if the symptoms continue after six to ten months. During the eye examination, the ophthalmologist/optometrist checks for anisometropia, which can affect about 10% of patients with congenital NLDO, and determines whether nasolacrimal duct probing is necessary [13].

Comparison with Contemporary Studies: Our study achieved a remarkable success rate of 92.3%, which aligns closely with recent literature demonstrating the effectiveness of conservative management for CNLDO. This success rate places our findings within the upper range of reported outcomes in contemporary studies. Similar High Success Rates: The success rate of 92.3% of patients in the current study is comparable to and different from data based on national and international research. These disparities could result from multiple factors, including poor technique, inadequate compliance, insufficient follow-up, and inadequate sample size.

Srivastava et al. (2023) reported an 84% overall success rate for congenital canaliculus stenosis using conservative treatment with Crigler massage, supporting our approach as one of the best options for treating infants and young children 8. The difference of 8.3% between our studies may be attributed to our more stringent diagnostic criteria and systematic exclusion of reflex tearing conditions. Their findings nonetheless validate the efficacy of conservative management while emphasizing the importance of proper technique application.

Irfan et al. (2020) demonstrated exceptional results with 93.49% complete resolution of epiphora and discharge following lacrimal sac compression [14]. This finding is remarkably similar to our 92.3% success rate, with only a 1.19% difference, suggesting consistency in treatment outcomes when proper technique and follow-up protocols are maintained. The similarity in results across different geographic regions indicates that cultural and regional factors may have minimal impact on treatment efficacy when standardized protocols are followed.

Age-Related Success Patterns: Mohney et al. (2022) reported an 89.7% resolution rate in patients during their second half-year of life with massage therapy [15]. The 2.6% difference from our results could be explained by their specific focus on older infants (6-12 months), whereas our study included a broader age range, with 56.2% of patients in the younger 0-6 month category, potentially contributing to our higher success rate.

Bansal et al. (2021) provided valuable insights through age-stratified analysis, reporting resolution rates of 87.3%, 78.9%, 77.9%, and 76.8% for groups aged 0-3 months, >3-<6 months, >6-<9 months, and >9-<12 months, respectively [16]. Interestingly, our study showed no statistically significant association between treatment success and age group ($p = 0.650$), which contrasts with Bansal's findings of declining success rates with increasing age. This difference could be explained by several factors:

1. **Sample size differences**: Our study included 130 patients compared to their larger cohort, potentially reducing the power to detect age-related differences.
2. **Treatment protocol variations:** Differences in massage frequency (our 10-15 times daily vs. their protocol) and follow-up intensity may have influenced outcomes.
3. **Geographic and demographic factors:** Different populations may respond variably to treatment based on genetic, environmental, or cultural factors affecting compliance.

Large-Scale Study Comparisons: Nanda et al. (2022) achieved an 86.75% complete healing rate following three months of constant lacrimal massage [17]. While their success rate is 5.55% lower than ours, their study encompassed a significantly larger sample size of 853 cases compared to our 130 patients. This larger sample size may have introduced greater variability in treatment compliance, technique execution, and patient selection criteria. Additionally, the multi-center nature of larger studies often leads to variations in training quality and follow-up consistency, which could explain the modest difference in outcomes. Sathiamoorthi et al. (2018) reported that 83.5% of CNLDO cases resolved through spontaneous healing or conservative care [18]. The 8.8% difference from our study may be attributed to their inclusion of both spontaneous resolution and active conservative management, whereas our study focused specifically on active Crigler massage intervention. This distinction is important as it suggests that active massage therapy may provide superior outcomes compared to passive observation alone.

Age-Stratified Outcomes Across Extended Periods: Lekskul et al. (2022) demonstrated dramatic age-related differences with resolution rates of 99.25%, 96.23%, 64.71%, 50%, and 62.07% for age groups 0-6 months, 6-12 months, 12-18 months, 18-24 months, and ≥24 months, respectively [19]. The striking decline in success rates after 12 months of age in their study contrasts with our finding of no significant age-related differences within the first year of life. This discrepancy suggests that the critical age threshold for treatment efficacy may be at 12 months rather than within the first year, supporting the importance of early intervention. According to Urban et al. (2020), numerous data from the literature show that 70-90% of CNLDO cases disappear spontaneously during the 1st year of life [20]. Our active intervention approach with a 92.3% success rate exceeds even the upper range of spontaneous resolution, highlighting the added value of structured massage therapy.

Compliance and Technique Impact: Karti et al. (2016) provided compelling evidence for the importance of compliance, comparing two groups with different adherence levels to Crigler massage. The compliant group achieved 92.2% success compared to 77.7% in the non-compliant group [21]. Our high success rate of 92.3% closely matches that of their compliant group, suggesting that our patient population exhibited excellent treatment adherence. The sample size and patient age differences, along with compliance levels, explain these variations in results. This comparison highlights several critical factors:

1. **Parental education quality:** Our structured training program and hands-on instruction may have contributed to better compliance.
2. **Follow-up intensity:** Regular monitoring at 1, 2, and 3 months likely reinforced proper technique and maintained motivation.
3. **Cultural factors:** The healthcare-seeking behavior and treatment compliance patterns in our study population may have been particularly favorable.
4. **Methodological Considerations** Affecting Comparisons
5. **Diagnostic Criteria and Patient Selection:** Referring the child to an ophthalmologist for a thorough eye exam is advised if symptoms continue after six to ten months. During the eye examination, the ophthalmologist checks for anisometropia, which can affect about 10% of patients with congenital NLDO, and determines whether nasolacrimal duct probing is necessary [13]. Our study used strict diagnostic criteria, including fluorescein disappearance testing and systematic exclusion of conditions causing reflex tearing. This careful approach likely contributed to our high success rate by ensuring accurate diagnosis of true CNLDO cases. Studies with less strict criteria might include cases of functional tearing disorders that respond poorly to massage therapy, thereby lowering overall success rates.

Treatment Protocol Variations: The variation in success rates across different studies may reflect differences in massage technique instruction, frequency recommendations, and adjunctive treatments. Our protocol of 10-15 daily massages with concurrent topical antibiotic therapy when indicated may represent an optimal balance of treatment intensity and practical feasibility. Several studies have reported varying protocols, providing insights into factors that influence treatment outcomes.

Geographic and Healthcare System Factors: Our study, conducted in Azad Jammu and Kashmir, achieved excellent results comparable to studies from developed countries, suggesting that with proper training and follow-up protocols, geographic location

does not significantly impact treatment success. However, studies from regions with limited healthcare access or different cultural approaches to infant care may show varying results. The variation in success rates across different studies may also reflect geographic and cultural factors affecting treatment compliance and healthcare delivery.

Clinical Practice Implications

Evidence-Based Treatment Selection: The consistency of high success rates across multiple well-designed studies, including our own, provides strong evidence supporting Crigler massage as the standard of care for CNLDO in infants under one year of age. The variations in success rates primarily reflect differences in patient selection, treatment compliance, and methodological approaches rather than fundamental differences in treatment efficacy.

Age Considerations: Studies by Zor et al. (2020) have shown that probing outcomes deteriorate in children older than 12 months, further supporting early conservative management [6]. This emphasizes the critical importance of early diagnosis and prompt initiation of conservative treatment.

Parental Counseling and Expectations: Parents experience relief when their child's nasal lacrimal duct obstruction resolves without requiring surgery. Conservative treatment for CNLDO should be the primary choice, according to consensus recommendations from all national and international research on Crigler massage with varying findings. Based on the comprehensive analysis of comparative studies, conservative treatment for CNLDO should remain the primary choice for initial management.

Future Research Directions and Limitations: Based on our comparative analysis with existing literature, several areas warrant further investigation:

1. Standardized Training Protocols: Development of universal training standards for parental instruction could reduce variability between studies and healthcare providers.

2. Long-term Outcome Studies: Extended follow-up periods could provide insights into the durability of conservative treatment success.

3. Digital Health Integration: Mobile applications or video-guided instruction tools could enhance treatment compliance and technique consistency.

The current study's findings demonstrate that Crigler massage, when performed correctly with firm but gentle pressure and adequate parental compliance, represents a highly successful approach for treating congenital nasolacrimal duct obstruction while avoiding surgical complications that may occasionally include bleeding and creation of false passages.

Conclusion: Crigler massage, involving the application of hydrostatic pressure to the lacrimal sac, remains the preferred first-line treatment for CNLDO. Conservative management should be prioritized, with the "wait-and-see" approach considered before surgical intervention. Addressing patient-specific factors, such as nasal co-morbidities, is critical to optimizing treatment outcomes. Proper parental training on the massage technique is essential for its effectiveness. These findings underscore the importance of non-invasive approaches in managing CNLDO and highlight the need for further research to refine conservative treatment strategies and improve patient care. Future studies may focus on standardized training protocols, long-term outcomes, and the role of adjunctive digital health tools for parental guidance, which could further enhance the practical application and global adoption of conservative management in CNLDO.

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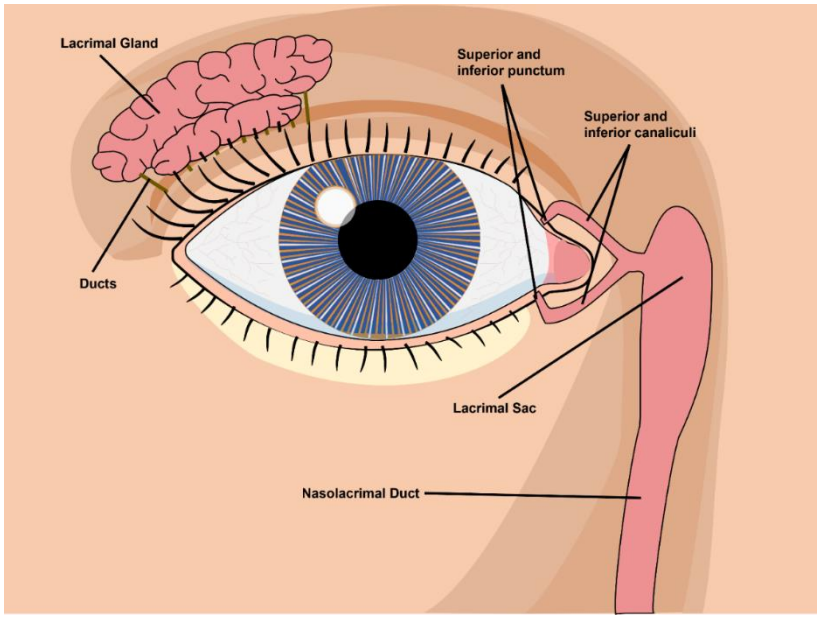

Fig 1. Tears from the lacrimal glands are spread across the eye with each blink, and excess fluid drains through the tear ducts into the nose

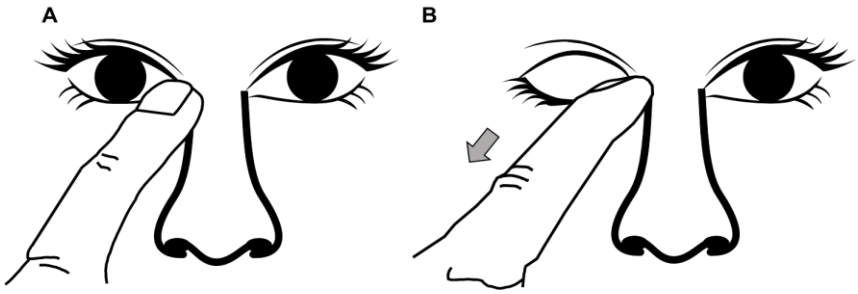

Fig 2. Technique for nasolacrimal duct (NLD) massage in infants and children with congenital NLD obstruction (dacryostenosis), crigler massage, A) Applying gentle pressure with the index finger over the superior aspect of the nasolacrimal sac. B) The membranous blockage at the bottom of the lacrimal duct ruptures when gentle but firm downward pressure is applied

Table 1. Clinical features and demographics of patients with persistent epiphora

Category	Subcategory	Frequency	Percent	Valid Percent	Cumulative Percent
Age	0-6 months	73	56.2	56.2	56.2
	6-12 months	57	43.8	43.8	100.0
	Total	130	100.0	100.0	
Gender	Male	57	43	43.8	43.8
	Female	73	56.2	56.2	100.0
	Total	130	100.0	100.0	
Eye Involvement	Unilateral (Right)	40	30.8	30.8	30.8
	Unilateral (Left)	46	35.4	35.4	66.2
	Bilateral	44	33.8	33.8	100.0
	Total	130	100.0	100.0	