RESEARCH ARTICLE

OUTCOMES OF NASOLACRIMAL INTUBATION IN CHILDREN AGED 1 TO 8 YEARS

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ABSTRACT

Objective: *To evaluate the outcomes of nasolacrimal duct (NLD) intubation in children aged 1-8 years having congenital nasolacrimal duct obstruction (CNLDO) and to compare success rates among different age groups.*

Study design: *Retrospective-Observational study.*

Place and Duration of study: *Al-Shifa Trust Eye Hospital, Rawalpindi. March-October 2023.*

Patients and Methods: *A total of 187 eyes from 162 pediatric patients aged 1–8 years who underwent NLD intubation were included. After exclusions, 156 eyes were analyzed. Patients were categorized into three age groups: Group A (1.1 to <3 years), Group B (3 to <5 years) and Group C (5 to 8 years). Success was defined by both subjective (resolution of tearing and discharge) and objective criteria (negative regurgitation test). Statistical analysis was performed using SPSS (Version 23.0) and intergroup comparisons were made using the Chi-square test.*

Results: *The overall success rate of NLD intubation was 68.59% with younger children demonstrating higher success rates. Group A had the highest success rate (83.67%) followed by Group B (64.86%) and Group C (58.93%), with a statistically significant difference (p = 0.0385). Complications occurred in 25 cases; tube extrusion (7 patients), cheese wiring of the puncta (5 patients), mucocoele, nasolacrimal fistula, and chronic dacryocystitis (1 patient each).*

Conclusion: *This study highlights that nasolacrimal intubation is more effective in younger children. The findings suggest that early intubation might prevent the need for multiple surgeries and reduce complications.*

Keywords: *Congenital Nasolacrimal Duct Obstruction, Nasolacrimal Duct Intubation, Regurgitation Test*

INTRODUCTION

Congenital nasolacrimal duct obstruction (CNLDO) is a prevalent condition affecting the pediatric population, characterized by epiphora, mucopurulent discharge, and recurrent conjunctivitis due to obstruction of the nasolacrimal drainage system.[1] It occurs due to delayed involution of the Hasners membrane at the Hasner valve in distal end of the duct.[2] It occurs in approximately 20% of newborns and resolves spontaneously in 90% of cases within the first year of life.[3] However, the rate of spontaneous resolution drops beyond 1 year of age and persisting CNLDO is associated with chronic dacryocystitis, pre-septal and orbital cellulitis, anisometropia and amblyopia.[4]

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Probing of the nasolacrimal duct is the primary treatment for persistent CNLDO after the first year of life. For older children, particularly those above 18 months of age, nasolacrimal duct intubation with silicone tubing has been increasingly utilized as either a primary or secondary intervention following failed probing.[5] Nasolacrimal intubation involves the insertion of a silicon tube through the lacrimal drainage system, providing a temporary stent to maintain duct patency and prevent restenosis.[6] This technique has been associated with higher success rates compared to repeated probing in older children as it mitigates the risk of inflammation and fibrosis which is associated with this age group and reduces the likelihood of requiring dacryocystorhinostomy.[7,8] Although nasolacrimal intubation is an invasive procedure, there are fewer associated complications. Tube extrusion and cheese wiring are among the most frequently encountered postoperative issues.[9] It is now increasingly used by

clinicians as a primary method in older children, in children having the procedure under general anesthesia, or when the duct feels tight during probing.[7] Jafarizadeh A et al reported outcomes of probing and nasolacrimal intubation in children over 18 months and found that out of 110 eyes, 13 (11.8 %) experienced failure while 97 (88.2 %) were censored.[5] Repka et al reported a success rate of 91% (95% confidence interval = 86% to 95%) for primary silicon intubation in 150 eyes of children aged less than 4 years of age.[6]

Despite the widespread adoption of nasolacrimal intubation, the impact of age on surgical outcomes remains a topic of debate and there is no defined optimal age for nasolacrimal intubation. There are few studies in the literature that reports the results of nasolacrimal intubation in children with a wider age range.[10,11] To the best of our knowledge, there is no study in the literature comparing success rates of primary intubation in different age groups. Furthermore, there is a paucity of local data of our population in this regard. This study aims to evaluate the outcomes of nasolacrimal duct intubation in children aged 1-8 years with CNLDO, assessing success rates across different age groups. By analyzing the efficacy of intubation in various pediatric age brackets, this study seeks to provide insights into optimal surgical management strategies and improve clinical decision-making in pediatric ophthalmology.

PATIENTS AND METHODS

This is a retrospective interventional cases series conducted at AlShifa Trust Eye Hospital, a tertiary care ophthalmology center, over a period of 8 months from 1st March 2023 till 31st October 2023. Ethical approval was obtained from the Ethical Review Committee. Informed consent was obtained from the legal guardians of all participants before surgery. Patient confidentiality was maintained throughout the study and no identifiable information was disclosed.

The study included pediatric patients aged 1-8 years who underwent nasolacrimal duct intubation due to persistent CNLDO. Inclusion criteria consisted of clinical diagnosis of CNLDO, and failure of conservative management, including lacrimal sac massage and topical antibiotics. Patients with secondary nasolacrimal duct obstructions due to trauma, congenital anomalies (e.g., craniofacial syndromes), or previous lacrimal surgeries were excluded. The diagnosis of CNLDO was clinical; based on the parents' complaints of persistent tearing or discharge and on examination, associated with increased tear lake, matting of eyelashes, and/ or positive regurgitation test (regurgitation of clear/ mucoid or pussy fluid on pressing the lacrimal sac). Slit lamp examination was done and other pathologies causing epiphora like conjunctivitis, glaucoma, eyelid abnormalities or ocular surface irritation were ruled out. Dilated fundus exam and cycloplegic refraction were done.

All intubation procedures were performed under general anesthesia by experienced pediatric ophthalmologists. The surgical protocol included initial lacrimal probing using Bowman probes to assess obstruction severity. Following the successful passage of the probe into the nasal cavity, a silicon bicanalicular stent was inserted and secured in place. The stent was left in situ for 2 to 12 months, based on surgeon preference and patient-specific factors. Postoperatively, all patients received topical antibiotics (e.g., moxifloxacin) and corticosteroid eye drops for a period ranging from 2 to 4 weeks followed by regular follow-up assessments. The study outcome examination was done 1 to 3 months from the date of tube removal. Treatment success labelled based on subjective (resolution of symptoms of tearing or discharge) and objective assessment i.e. absence of clinical signs of NLDO (epiphora, increased tear film, and mucous discharge). Patient demographic data, clinical presentation, surgical details, and postoperative outcomes were extracted from medical records. Children were grouped according to age as follows:

- Group A: 13 to 31.9 months (1.1 to <3years)
- Group B: 33 to 59.9 months (3 to <5 years)
- Group C: 60 to 84 months (5 to 8 years)

Data were analyzed using SPSS (Version 23.0, IBM Corp.), with categorical variables compared using the chi-square test and continuous variables assessed via independent t-tests. Logistic regression analysis was performed to evaluate the association between age and surgical success, with a significance level set at p-value < 0.05.

RESULTS

A total of 187 eyes from 162 patients underwent nasolacrimal duct (NLD) intubation. However, 17 cases were lost to follow-up and subsequently excluded. Additionally, four cases were deemed unsuitable for intubation due to anatomical anomalies, including absent puncta and canaliculi or severe punctal stenosis. Furthermore, five cases experienced spontaneous tube extrusion within two weeks of the procedure and were

also excluded. As a result, the final analysis comprised 156 eyes with 83 males (53.21%) and 73 females (46.79%). The mean age was 3.88 years.

The success rate of NLD intubation varied significantly across different age groups ($\chi^2 = 8.55$, $p = 0.0385$). The highest success rate was observed in children aged 1–2 years (Group A), with an overall success rate of 83.67%. Conversely, children aged 5–8 years (Group C) exhibited the lowest success rate at 58.93%. The success rates for each group were as follows:

- Group A (1–2 years): 83.67% success rate
- Group B (3–4 years): 63.04% success rate
- Group C (5–8 years): 58.93% success rate

Gender-specific analysis revealed a notable difference in success rates. Males in Group A had a significantly higher success rate (92.31%) compared to females (73.91%). Similarly, in Group B, females exhibited a success rate of 74.07%, whereas males had a lower success rate of 52.17%. In Group C, success rates remained comparable between genders, with males achieving a success rate of 57.58% and females 60.87%.

Independent t-test results have *p*-value less than 0.05, hence there is a statistically significant difference in age between the successful and unsuccessful groups. Logistic regression analysis revealed that age is significantly associated with surgical success ($p = 0.008$). The negative coefficient suggests that as age increases, the likelihood of success decreases. The model explains a small proportion of variability in success rates, implying other factors may influence outcomes.

In terms of complications, 25 cases (16.03%) experienced adverse outcomes. The most common complication was tube extrusion, reported in seven cases. Additionally, five patients exhibited cheese wiring of the puncta. Other complications included mucocoele formation, nasolacrimal fistula, and chronic dacryocystitis, with one patient each.

Table I: Independent t-test Results

Variable	Success (Mean ± SD)	Failure (Mean ± SD)	t(154)	*p*-value	95% CI (Lower, Upper)
Age (years)	3.57 ± 1.52	4.52 ± 1.68	3.214	0.0017	(0.35, 1.52)

Table II: Logistic Regression Analysis

Predictor	B (Estimate)	SE	Wald χ^2	*p*-value	Exp(B) (Odds Ratio)	95% CI (Lower, Upper)
Intercept	1.7546	0.682	6.622	0.010	-	-
Age	-0.2409	0.091	6.977	0.008	0.786	(0.658, 0.940)

Note: SE = Standard Error, CI = Confidence Interval

Table III: Success and Failure Rates Across Age Groups and Genders

Age Group	Gender	Failure Count	Success Count	Total Cases	Success Rate (%)	Failure Rate (%)	*p*-value
A (1-2 years)	Female	6	17	23	73.91	26.09	**0.0385**
	Male	2	24	26	92.31	7.69	**0.0385**
B (3-4 years)	Female	7	20	27	74.07	25.93	**0.0385**
	Male	11	12	23	52.17	47.83	**0.0385**
C (5-8 years)	Female	9	14	23	60.87	39.13	**0.0385**
	Male	14	19	33	57.58	42.42	**0.0385**

Note: Success and failure rates are expressed as percentages. The *p-value* represents statistical significance across age groups, with $p < 0.05$ indicating a significant difference.

Table IV: SPSS Analysis

Statistic	Value
Chi-Square (χ^2)	8.55
Degrees of Freedom (df)	2
p-Value	0.0385

DISCUSSION

The existing literature has no consensus on the optimal timing of probing and nasolacrimal intubation, although it acknowledges probing as the standard treatment for CNLDO. Nasolacrimal duct intubation was introduced in the late 1960s used initially as a secondary procedure after failed probing.[3] Orhan et al reported a success rate of 100% in children aged 18-48 months, in 37.5% of cases as a primary procedure and 62.5% as secondary.[12] PEDIG conducted a prospective, multicenter, non-randomized study on primary silicon intubation in children aged 6 to 45 months and reported a success rate of 90%. While some studies reported a decline in success rates with increasing age due to chronic inflammation and fibrosis[7,1] others suggested no significant correlation between age and treatment success.[13] Additionally, factors such as surgical technique, stent type and duration of tube retention contributes to variable outcomes. Engel et al conducted a retrospective case series of 635 patients aged 6 to 104 months for monocanalicular intubation as the primary treatment for CNLDO with an overall success rate of 96%.[14] The timing of tube removal is usually after 2 to 6 months, however, keeping the tube for more than 3 months has been reported to have a higher success rate in older children.[15] Lim et al. illustrated success rates of 83 to 100% in children aged 1 and 4 years with significantly higher rates of failure if the tube is retained for more than 18 months.[13]

The findings of this study provide significant insights into the success rates of nasolacrimal intubation across different pediatric age groups. The overall success rate varied significantly among different age cohorts (p = .0385), highlighting the impact of age on surgical outcomes. The highest success rate was observed in children aged 1–2 years (83.67%), while the lowest success rate was noted in children aged 5–8 years (58.93%). These findings highlight that younger children, particularly those aged 1–2 years, have significantly higher success rates following the nasolacrimal intubation. Meanwhile, older children especially those aged 5–8 years, exhibited lower success rates and an increased likelihood of requiring additional interventions. These findings align with prior studies which suggest earlier intervention is associated with better outcomes in congenital nasolacrimal duct obstruction (NLDO).[6,16]

The age-related differences in success rates may be attributed to the structural and physiological changes that occur in the nasolacrimal duct as the child grows. Infants and younger children typically have a more compliant ductal system, which may facilitate tube placement and improve surgical success. Conversely, older children may have more fibrotic obstructions, leading to lower success rates and higher failure rates.[17] These findings suggest that early nasolacrimal silicon intubation as a primary procedure could be beneficial for optimizing treatment outcomes in CNLDO cases.

The relatively low rate of serious complications in this study indicates that nasolacrimal intubation remains a safe and effective procedure. However, careful patient selection, precise surgical technique, and close postoperative monitoring are essential for minimizing adverse outcomes.

Given the findings of this study, several clinical recommendations can be made. Early intervention with primary nasolacrimal intubation (preferably between 1–2 years of age) is recommended for optimal surgical outcomes. Conventional approach or probing, repeat probing, and secondary intubation involves multiple procedures done in general anesthesia. Postoperative monitoring is crucial to manage complications such as tube extrusion and cheese wiring which if untreated, could lead to long-term lacrimal dysfunction. Future research should focus on refining surgical techniques to improve outcomes in older children and high-risk subgroups.

While this study offers valuable insights, several limitations exist. A selection bias may occur due to the retrospective nature of this study. Second, the sample size for certain age and gender subgroups was relatively small, which may limit the generalizability of the findings. Nasolacrimal intubation was done by different surgeons with varying levels of surgical expertise and there was no fixed time interval for retention of tubes. Additionally, long-term follow-up data was not included, preventing an assessment of recurrence rates or long-term efficacy of the procedure. Future prospective studies with larger, more diverse populations and extended follow-up periods are needed

to further validate these results.

CONCLUSION

In conclusion, this study highlights the significant impact of age and gender on the success rates of nasolacrimal intubation. The highest success rates were observed in younger children (1–2 years old), reinforcing the importance of early intervention. Gender-based differences were also evident, suggesting potential anatomical or physiological factors that warrant further investigation. Future research should focus on refining surgical techniques and identifying factors that contribute to treatment success or failure.

CONFLICT OF INTEREST

None.

SOURCE OF FUNDING

None.

ETHICAL APPROVAL

Ethical approval was obtained from the Ethical Review Committee of AlShifa Trust Eye Hospital, Rawalpindi (vide ref no. ERC-50/AST-24, dated 11/12/2024) ensuring compliance with all regulatory and ethical guidelines for human research. Informed consent was obtained from the parents or legal guardians of all pediatric participants before enrollment in the study. Confidentiality and patient anonymity were strictly maintained throughout the research process.

Authors' Contributions:

Shafaq Najmi: Conception of study/Designing/Planning

Sumaira Altaf: Experimentation/Study Conduction

Ambreen Yousaf: Analysis/Interpretation/Discussion

Najia Uzair: Manuscript Writing, Critical Review

Rebecca Murtaza: Critical Review

Adila Anwar: Facilitated for Reagents/Material Analysis, Critical Review

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