Aim: To determine the success rate of initial and repeated probing for congenital nasolacrimal duct obstruction (CNLDO) in children between 2-41 months.

Patients and methods: One hundred and twelve children aged 1.8 to 13 years responded to the control examination. They were diagnosed with CNLDO in the past and now included in a retrospective study. The mean follow-up period was 5.2 years (from 0.6 to 11.6 years). Patients were divided into two groups according to their age at the time of surgery: group A (2-12 months) and group B (13-41 months). Probing and irrigation of NLD was performed in the Eye Clinic in Pleven under general anesthesia in all subjects.

A controlled examination was done to evaluate the effect of probing on the basis of a history of watery eyes, regurgitation test, and dye disappearance test (DTT).

Results: Of the 131 eyes in 112 children, 110 eyes (84%) had one probing and 21 eyes (16%) had repeat probing. Success rate of the initial probing was 90% (99 of 110) for all patients’ eyes: 89% (70 of 79) in group A and 94% (29 of 31) in group B. The cure rate of the repeat probing was 76% (16 of 21) for all patients: 88% (7 of 8) in group A and 69% (9 of 13) in group B. The overall success rate of probing was 88% (115 of 131).

Conclusion: Nasolacrimal duct probing followed by irrigation is a commonly performed, highly successful treatment for congenital nasolacrimal duct obstruction in children. The success rate for initial and repeated nasolacrimal duct probing is not affected by age.
PATIENTS AND METHODS
A retrospective study was undertaken at the Department of Ophthalmology, University Hospital, Pleven, Bulgaria. The Committee of the Ethics of Research Activities in Medical University of Pleven reviewed and approved the protocol for this study. Examination of the medical records between 2006 and 2016 identified 224 children with CNLDO who had undergone probing and irrigation of the nasolacrimal duct for tearing and discharge since early infancy. The parents signed informed consent for the participation of their child in the study.

Samples consisted of 131 eyes of 112 consecutive patients. The children’s age was between 1.8 and 13 years during the control examinations of which the aim was to determine the effect of probing. The mean follow-up period was 5.2 years (range 0.6 to 11.6 years). The age of the patient at the time of probing was recorded. Children were divided into two groups according to their age at the time of surgery, group A including children 2 - 12 months old and group B including children 13 to 41 months old.

Prior to initial probing, enrolled subjects did not receive any therapy besides lacrimal sac massage and/or topical antibiotics. In all cases, nasolacrimal duct probing was performed under brief inhalation general anesthesia in the operating room in stepwise manner using Bowman’s probe size 1. Probing was done through the upper and lower punctum after dilatation and then passed through the canaliculus on the way to the medial wall of the lacrimal fossa. The probe was turned to enter the nasolacrimal duct, and gently advanced until resistance was felt. The probe was then advanced to overcome the obstruction. The patency of the lacrimal drainage system was confirmed by saline irrigation. All surgeries were performed by a single surgeon. After probing, patients were given antibiotic and steroid eye drops, four times daily, for one week.

If the initial probing was unsuccessful, repeated probing was performed on average 4 (from 2 to 8) months after it.

The result of initial and repeated probing in these patients was evaluated on the basis of a history of watery eyes, regurgitation test, and dye disappearance test (DDT). The postoperative examiner for these tests was the same doctor. Parents were asked if there is tearing from their child’s eyes. Regurgitation test was done by pressure above the lacrimal sac with index finger and observed for reflux from the puncta. Dye disappearance test was performed by instilling one drop 2% fluorescein into the unanesthetized conjunctival fornix of each eye. After 5 minutes, the thickness of the fluorescence of the tear meniscus was measured with the help of cobalt blue filter. The tears normally drain down the system in 5 minutes. This is an excellent quantitative test to measure lacrimal drain function, especially in children.17

The fluorescein dye test grading scale in this study is as follows:18

- 0 - no fluorescence in the conjunctival sac
- 1 - thin fluorescing marginal tear strip persists
- 2 - more fluorescein persists, between 1 and 3
- 3 - wide, brightly fluorescing tear strip

Successful probing was documented as complete remission of watering and discharge together with no reflux from lacrimal sac pressure and 0 or 1 grade of the dye disappearance test. Probing with questionable effect was found for children with intermittent tearing from the eyes, no reflux from lacrimal sac pressure and DDT grade 2. Probing was unsuccessful when there were permanent tearing from the eyes, reflux from lacrimal sac pressure, and DDT grade 3.

The data from the examinations was statistically mapped out and analyzed using Microsoft Excel and Statgraph. The declared p-values came from the chi-square test and Fisher’s exact test (FET). A p<0.05 was considered significant.

RESULTS
Of the 224 children, only 112 (50%) probed children and their parents responded. The demographic profile of the evaluated children was: 56 (50%) males and 56 (50%) females; 95 (85%) children living in the city and 17 (15%) in the village; 36 (32%) children with affected right eye and 42 (38%) with affected left eye, and 34 (30%) individuals with bilateral CNLDO after their birth.

The patients were divided into two groups (group A - 2-12 months old, and group B 13-41 months old), according to the age at which probing was performed. Demographic distribution of patients is presented in Table 1.

Out of the 112 children (131 eyes), 95 children (110 eyes) were once probed, and 17 children (21 eyes) were twice or more times probed. The success rate of the initial probing was 90% (99/110 eyes) and 76% (16/21 eyes) of the repeated probing. The effect of the initial and repeated probing in Group A and B is shown in Table 2.

One girl of the children in this study had a successful silicone intubation on the right eye made...
in another Eye Hospital. Before the intubation she had had two failed probings of the same eye in our hospital. Her age at the time of the second probing was 22 months. She was included in group B of the unsuccessful, unilateral and repeated probing.

Ninety three children (83%) were unilaterally probed and 19 children (17%) were bilaterally probed. In 15 children with bilateral obstruction, one eye was healed as a result of a massage before the probing and the procedure was done only on the other affected eye. Cure rate in unilateral cases was 90% (84/93) and in bilateral cases 82% (31/38) (Table 3). In the two groups it is divided as shown in Table 4.

The overall success rate of probing was 88% (115/131). The distribution by age group is shown in Table 5.

**DISCUSSION**

Probing of NLD is the first choice of surgical treat-

| Demographic profile | Group A (2-12 months) | Group B (13-41 months) | Total Children |
|---------------------|-----------------------|------------------------|----------------|
| Cases               | 71 (63%)              | 41 (37%)               | 112            |
| Mean age            | 8.97 ±0.47 (95% CI 8.50-9.44 SD 1.99) | 18.32 ±2.00 (95% CI 16.32-20.32 SD 6.34) |            |
| Male                | 31 (55%)              | 25 (45%)               | 56             |
| Female              | 39 (70%)              | 17 (30%)               | 56             |
| Right eye           | 20 (56%)              | 16 (44%)               | 36             |
| Left eye            | 27 (64%)              | 15 (36%)               | 42             |
| Both eyes           | 24 (71%)              | 10 (29%)               | 34             |
| City                | 60 (63%)              | 35 (37%)               | 95             |
| Village             | 11 (65%)              | 6 (35%)                | 17             |

**Table 2. Effect of the initial and repeated probing in Group A and B**

| Sequence of probing | Effect of probing | Group A | Group B | Total eyes |
|---------------------|-------------------|---------|---------|------------|
| Initial             | Successful        | 70 (89%)| 29 (94%)| 99         |
|                     | Questionable effect| 8 (10%) | 2 (6%)  | 10         |
|                     | Unsuccessful      | 1 (1%)  | 0 (0%)  | 1          |
| Repeated            | Successful        | 7 (88%) | 9 (69%) | 16         |
|                     | Questionable effect| 1 (12%) | 0 (0%)  | 1          |
|                     | Unsuccessful      | 0 (0%)  | 4 (31%) | 4          |

**Table 3. Effect of probing in all cases by laterality**

| Effect of probing | Unilateral | Bilateral |
|------------------|------------|-----------|
| Successful       | 84 (90%)   | 31 (82%)  |
| Questionable effect | 5 (5%)   | 6 (16%)  |
| Unsuccessful     | 4 (5%)     | 1 (2%)    |
ment in the management of CNLDO. Two options exist: office probing with topical anesthesia at the age of 4 to 6 months or observation and medical management followed by probing under general anesthesia at approximately 12 months. When deciding whether a general anesthetic should be used for the probing, the most obvious concern is the risk associated with general anesthesia especially in children less than 6 months of age.

In our study there were only six children under the age of 6 months. They were diagnosed with acute dacryocystitis or congenital dacryocystocele. We treated them with probing under general anesthesia once the initial inflammation was resolved. In all other cases of children over 6 months of age with uncomplicated CNLDO, probing was also performed under general anesthetic. We preferred this type of anesthesia because it provided comfort to the surgeon and reduced the risk of injury by probing with topical anesthesia. All parents gave informed consent in any decision regarding the choice of the use of a general anesthetic. There were no complications resulting from the used general anesthesia.

The overall cure rate of probing for different studies varies from 84% to 92%. In this study, an overall success rate of 88% was found, which is consistent with the results of these researchers. This high efficiency gives a good prognosis of surgical treatment of nasolacrimal duct probing at all. According to our results for initial and repeated probing, cure rate does not vary significantly at intervals of increasing age (χ²=0.215, df=1, p =0.643).

Many case series have reviewed the outcomes of initial probing in the treatment of CNLDO. However, controversy exists regarding the timing of probing and its outcome in children older than 1 year. All authors found high cure rate of probing in children up to 12 months of age. Some of them also reported high success (up to 86%) rate of probing as the first choice of treatment for children older than 13 months. Based on the study of Mac Ewen and Young who followed a cohort of nearly 4792 infants and found that spontaneous remission occurred throughout the year and 96% had healed before the age of one, they advised late probing after 1 year of age. According to other authors, there is a significant trend of decreasing success rates with increasing age. They offered probing until 6 months suggested that early correction avoids months of morbidity due to epiphora and chronic dacryocystitis. Here, a cure rate of initial probing was 89% in the younger age group and 94% in the oldest group. Therefore age and efficacy of the first probing were not be inversely correlated (χ²=0.588, df= 1, p = 0.443). That is why we supported late probing although we had cases of probed children before 6 months of age. The reason these children

### Table 4. Effect of probing in Group A and B by laterality

| Laterality | Effect of probing | Group A | Group B |
|------------|------------------|---------|---------|
|            | Successful       | 52 (95%)| 32 (84%)|
|            | Questionable effect | 3 (5%)  | 2 (5%)  |
|            | Unsuccessful     | 0 (0%)  | 4 (11%) |
|            | Successful       | 25 (78%)| 6 (100%)|
|            | Questionable effect | 6 (19%) | 0 (0%)  |
|            | Unsuccessful     | 1 (3%)  | 0 (0%)  |

### Table 5. Overall success rate of probing in Group A and B

| Group | No. of eyes | Successful probing | Probing with questionable effect | Unsuccessful probing |
|-------|-------------|--------------------|---------------------------------|----------------------|
| A     | 87          | 77 (89%)           | 9 (10%)                         | 1 (1%)               |
| B     | 44          | 38 (86%)           | 2 (5%)                          | 4 (9%)               |
| Total | 131         | 115 (88%)          | 11 (8%)                         | 5 (4%)               |
younger than 6 months underwent probing was due to complicated CNLDO.

Several case series have reviewed the outcomes of repeated probing in the treatment of persistent CNLDO. They found that late management of CNLDO increased the number and complexity of future procedures.13,28

However, other researchers found that the success rates of repeated probing did not decrease with age.29

We found 88% cure rate of repeated probing for subjects aged 2 to 12 months and 69% for subjects aged 13 to 41 months. Although the total number of patients was relatively small, the success rate of the repeated probing was not be affected by patient age (p=0.607, FET). So if primary probing failed, we prefer a repeat procedure rather than the silicone intubation proposed by other authors.30

According to some studies, bilateral symptoms are present in about 8-15% of children with CNLDO.22,25,31 In our study, 17% of patients underwent bilateral probing, which slightly exceeds the results of the researches.

As per some studies10,28,32 unilateral and bilateral cases were considered as independent correlates to successful probing and there were no significant associations. Here the success rate of the probing was 90% in unilaterally affected patients, and 82% in bilaterally cases ($\chi^2=1.345$, $df=1$, $p=0.246$) which confirms the above results.

One limitation of our study was the limited scope of the older age group. For more reliable results, the sample of the older children needs to be more numerous. Other limitations are that there was no collected data regarding obstruction type as well as the type of the stop ‘hard’ or ‘soft’) during probing impression. Complex type obstruction (bony obstructions, craniofacial syndromes, and buried probe) is more resistant to probing and result in worse success rates while simple type (membranous obstruction) has a high cure rate.33 The type of obstruction must be reported in a further study where the effect of such factors on the success of probing for CNLDO is identified. The differentiation between the ‘hard stop’ and ‘soft stop’ is essential because the treatment of obstruction at the sac or duct versus the common canaliculus requires different techniques.

CONCLUSIONS

Nasolacrimal duct probing followed by irrigation is a commonly performed procedure and a highly successful treatment for congenital nasolacrimal duct obstruction in children. Our results indicate that the success rate for initial and repeated nasolacrimal duct probing is not affected by age. Based on these results, we contend that probing should be the initial treatment of choice for children with CNLDO, if this fails, second probing should be employed regardless of the age of the child.

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Показатель успешности исследования при врождённой обструкции носослёзного канала у детей

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Цель: Определить частоту успешных начальных и повторных исследований при врождённой обструкции носослёзного канала (ВОНСК) у детей в возрасте от 2 до 24 месяцев.

Пациенты и методы: Сто двенадцать детей в возрасте от 1,8 до 13 лет соответствовали условиям при контролльном обследовании. В прошлом им был поставлен диагноз ВОНСК, а теперь они были включены в ретроспективное исследование. Средний период наблюдения составил 5,2 года (от 0,6 до 11,6 года). Пациенты были разделены на две группы в зависимости от их возраста во время операции: группа А (2-12 месяцев) и группа В (13-41 месяц). Зондирование и промывка НСК проводились в Офтальмологической клинике - Плевен под общим наркозом для всех субъектов.

Был проведен скрининг для оценки эффекта зондирования на базе анамнеза слезоточивости глаз, теста на регургитацию и канальцевой пробы с флюоресцеином (dye disappearance test (DTT)).

Результаты: Из 131 глаза, обследованных у 112 детей, 110 глаз (84%) прошли одно зондирование, а 21 глаз (16%) – повторное зондирование. Частота успешного первичного зондирования составила 90% (99 из 110) для глаз всех пациентов: 89% (70 из 79) в группе А и 94% (29 из 31) в группе В. Процент вылеченных пациентов с повторным зондированием составил 76% (16 из 21) для всех пациентов: 88% (7 из 8) в группе А и 69% (9 из 13) в группе В. Общий показатель успешности составил 88% (115 из 131).

Выводы: Зондирование носослёзного канала, за которым следует промывание, часто используется и является чрезвычайно успешным в лечении врождённой обструкции носослёзного канала у детей. Успешность первоначального и повторного зондирования носослёзного канала не зависит от возраста пациентов.