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Evaluating the outcomes of children undergoing lacrimal surgery for congenital nasolacrimal duct obstruction with the aim of developing a patient pathway for children presenting to a tertiary paedatric service with epiphora

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Abstract

Objective. Nasolacrimal duct obstruction is the most common cause of epiphora in children. Management has classically focused on probing and syringing followed by stent insertion and dacryocystorhinostomy either externally or endonasally. This study aimed to assess the effectiveness and safety of these procedures.

Methods. This was a retrospective analysis of the outcomes of all patients under the age of 16 who have undergone a surgical lacrimal intervention for nasolacrimal duct obstruction under general anaesthetic over a 10-year period. Outcomes included success rates and complications.

Results. A total of 432 patients were identified. Primary probe and syringing had a success rate of 83 per cent. Primary endonasal dacryocystorhinostomy had a success rate of 71 per cent, and revision surgery had a success rate of 82 per cent.

Conclusion. Endonasal dacryocystorhinostomy is an effective and safe technique for the treatment of epiphora, and this study has provided a suggested protocol for management of patients presenting with epiphora.

Introduction

Congenital nasolacrimal duct obstruction is the most common disorder of the lacrimal system, affecting between 6 and 20 per cent of all newborns.[1,2] Despite the high incidence of the condition, the rate of spontaneous resolution is also high. Multiple studies into the natural history of the disease concluded that up to 95 per cent of all children would be symptom free within the first year of life.[3,4] Spontaneous resolution within the first three months of life has been estimated to be 70 per cent. Management in children less than one year old is mainly conservative.[5–7] Topical antibiotics are used only when acute infections arise. Lacrimal massage is often recommended as an adjunct to conservative therapy and has been shown to be useful. Regular lacrimal sac massage has been shown to improve the rate of spontaneous resolution by approximately 16 per cent (from 77 per cent in non-massage patients to 93 per cent in massage patients).[8]

The most common aetiology of congenital nasolacrimal duct obstruction is imperforate membrane at the valve of Hasner, where the lacrimal system enters and drains into the nasal cavity, secondary to incomplete canalisation of the lacrimal system.[5]

Complications of untreated epiphora include dacryocystitis, conjunctivitis and preseptal cellulitis, all of which can be recurrent in nature.[3,4,9] There have also been reports that children with congenital nasolacrimal duct obstruction are at increased risk of developing anisometropic amblyopia.[10] It is unclear whether this is as a consequence of blurred vision during a key developmental period or whether children with congenital nasolacrimal duct obstruction have an increased risk of having other amblyopic risk factors.[11] Because of these complications, surgical treatment of congenital nasolacrimal duct obstruction is recommended in the small proportion of patients whose epiphora does not spontaneously resolve. Current surgical options include nasolacrimal probing and syringing, nasolacrimal stent insertion, standard (external) dacryocystorhinostomy and endonasal dacryocystorhinostomy.[9,12–14] There has been clinical equipoise about the most effective method of treating congenital nasolacrimal duct obstruction with these procedures.

Aim

We aimed to: identify the number of patients undergoing a surgical intervention for nasolacrimal duct obstruction; identify which surgical procedure was performed, the success rate of each intervention and also the average number of procedures each patient required

Main Article

Dr P Sooby takes responsibility for the integrity of the content of the paper

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prior to resolution of symptoms; and to describe the age, sex and significant past medical history of these patients. Using these data, we aimed to produce a patient pathway for children presenting to the out-patient department with epiphora.

Methods

A retrospective case note analysis of all patients under the age of 16 years old undergoing lacrimal surgery within the Glasgow and Greater Clyde NHS Trust between January 2007 and November 2017 was performed. Patients were identified using a search of the electronic operating theatre manager by searching for the operation codes for nasolacrimal probe and syringing, lacrimal stent insertion, endonasal dacryocystorhinostomy, dacryocystorhinostomy, external dacryocystorhinostomy and lacrimal other. Patients were excluded if the procedure performed was not performed for epiphora or if the patient had another diagnosis that would have caused the epiphora (e.g. imperforate puncta).

There was a subsequent review of the included patients' electronic notes. From this information, a dataset including age, sex, significant past medical history, number of procedures performed, type of procedure performed and success rates was collected and collated. These results were then analysed using the chi-square statistical test.

We also performed an analysis of the patients who underwent endonasal dacryocystorhinostomy. Patient records were used to identify the rate of complications from the operation, the duration of nasolacrimal stent insertion and whether this duration differed between the success and failure groups.

Results

A total of 445 patients were identified, and the total number of procedures performed was 558 between January 2007 and November 2017. The average age of the patient was 3.2 years, and the male to female distribution was equal. Fifty patients, with an average age of 5.2 years, had been initially referred to ENT, and 395 patients, with an average age of 2.9 years, had been initially referred to ophthalmology. The most common procedure was primary probe and syringing, which was performed 418 times. The success rate of this procedure was 83 per cent. Secondary or revision probing and syringing was performed 46 times, with a success rate of 89 per cent. A small number of patients ($n = 3$) underwent a third probe and syringe, which had a 100 per cent success rate.

The second most common procedure was primary endonasal dacryocystorhinostomy, performed 55 times. The overall success rate of a primary dacryocystorhinostomy was 71 per cent, with patients having undergone an average of 1.93 procedures prior to resolution of symptoms. Twenty-seven of the 55 primary endonasal dacryocystorhinostomies were performed as the primary surgical procedure. If these patients are excluded, the remaining patients (universally referred to otolaryngology by ophthalmology) underwent an average of 2.7 procedures prior to the resolution of symptoms. Where dacryocystorhinostomy was unsuccessful, a revision endonasal dacryocystorhinostomy was performed ($n = 11$), with a success rate of 83 per cent.

External dacryocystorhinostomy was performed on 11 patients, with a success rate of 91 per cent and with patients undergoing an average of 2.36 procedures prior to symptom resolution. Eighteen per cent ($n = 2$) of patients undergoing external dacryocystorhinostomy had undergone a previously unsuccessful endonasal procedure. Lacrimal stent insertion (without dacryocystorhinostomy) was performed 14 times and had a success rate of 85 per cent and an average of 1.78 procedures prior to symptom resolution. The results from the analysis are shown in Table 1.

The rate of complications within the primary endonasal dacryocystorhinostomy group was 16 per cent. All complications were infectious in nature and were treated with either topical or oral antibiotics. There were no long-term complications from endonasal dacryocystorhinostomy. The average length of stent insertion was 7.6 months in the success group and 9.4 months in the failure group. This was found not to be statistically significant using the one-sample t-test ($p = 0.35$).

Discussion

Congenital nasolacrimal duct obstruction is a very common condition in children, which is usually self-limiting. However, in the group where epiphora persists, the condition can lead to infectious or ophthalmic complications. A range of procedures are available to treat the congenital nasolacrimal duct obstruction, including nasolacrimal probing and syringing, nasolacrimal stent insertion, and endonasal or external dacryocystorhinostomy. There is debate in the literature about which procedure is of most benefit. Our experience has shown that nasolacrimal probing and syringing, dacryocystorhinostomy (both endonasal and external) and stent insertion are all effective treatments for children with epiphora. The rate of success for primary endonasal dacryocystorhinostomy is within the range that has been described within other literature for the paediatric population (58–100 per cent).

Nasolacrimal syringing and probing is the least invasive procedure. The procedure does appear to be very effective in treating congenital nasolacrimal duct obstruction. The success rate is 83 per cent from our data, and from previous studies, the procedure appears safe and has a low rate of complications. The procedure can be repeated if needed, with similar success rates.[15,16]

Endonasal dacryocystorhinostomy is a procedure in which the nasolacrimal sac is opened via the nasal cavity, and the opening is stented with a silicone stent. These stents are then removed endonasally, although the time frame for this is debatable. The operation is performed endonasally and does not cause a facial scar, an advantage over external dacryocystorhinostomy. Our data showed endonasal dacryocystorhinostomy to be safe and effective, with no major complications of the operation observed. Although not observed in our series, reported complications include bleeding, infection, intra-nasal synechiae, stenosis of the dacryocystorhinostomy ostium, orbital injury and cerebrospinal fluid leak.

Within our service, there are two referral routes for children presenting with epiphora. The most common route is to the ophthalmology department, where if a diagnosis of congenital nasolacrimal duct obstruction is suspected, the first procedure to be performed would most likely be a probe and syringe. If ophthalmological interventions are unsuccessful, then patients may be referred on to the ENT department for consideration of an endonasal dacryocystorhinostomy. However, if the child was referred to the ENT department, then a proportion of the patients ($n = 11$) underwent a primary endonasal dacryocystorhinostomy. Patients within the primary endonasal dacryocystorhinostomy group underwent a mean of 1.93 procedures prior to the resolution of symptoms. However, when controlling for the group who underwent primary endonasal

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Table 1. Results of nasolacrimal interventions grouped by procedure

Procedure	Procedures (*n*)	Procedures performed prior to symptom resolution (mean; *n*)	Success rate (%)	Average age of success & failure groups (mean; years)
Primary probing & syringing	418	1.0	83	Overall – 2.68 Success – 2.53 Failure – 6.42
Revision probing & syringing	46	2.0	89	Overall – 2.36 Success – 2.26 Failure – 3.6
2nd revision probing & syringing	3	3.0	100	Overall – 2.37 Success – 2.37 Failure – None
Lacrimal stent insertion	14	1.78	85	Overall – 4.16 Success – 4.22 Failure – 3.40
Primary endonasal DCR	55	1.93	71	Overall – 3.8 Success – 3.98 Failure – 3.80
Revision endonasal DCR	11	2.18	82	Overall – 3.22 Success – 3.13 Failure – 4.0
External DCR	11	2.36	91	Overall – 5.09 Success – 5.19 Failure – 4.10

The rate of complications within the primary endonasal dacryocystorhinostomy (DCR) group was 16 per cent. All complications were infectious in nature and were treated with either topical or oral antibiotics. There were no long-term complications from endonasal DCR. The average length of stent insertion in the success group was 7.6 months and 9.4 months in the failure group. This was found not to be statistically significant using the one-sample *t*-test ($p = 0.35$).

dacryocystorhinostomy without any prior procedure, patients underwent a mean of 2.7 procedures.

In the group where endonasal dacryocystorhinostomy was performed as the first procedure, the success rate was 79 per cent. This success rate drops to 71 per cent when endonasal dacryocystorhinostomy was performed as the second procedure and then 50 per cent when performed as the third procedure. This association was not shown to be statistically significant, although the numbers in each group were very low, predisposing this data to type 2 error.

Following this observation, we have suggested the following patient pathway for children presenting with epiphora. We recommend the use of conservative measures, including watching and waiting as well as lacrimal massage, for children under the age of one year because of the high spontaneous resolution rate. If symptoms persist, then we would suggest procedures dependent on the child's age. In children under the age of three years, we advocate a primary nasolacrimal probe and syringe because of its efficacy and lack of invasiveness. Should this be unsuccessful, we would advocate referral for consideration of endonasal dacryocystorhinostomy. This is because our data suggest that repeated probing and syringing may reduce the efficacy of endonasal dacryocystorhinostomy should it be required. Should the primary probe and syringe be partially successful, then repeated probe and syringe with or without nasolacrimal stents could be considered. In children over the age of three, we recommend proceeding to primary endonasal dacryocystorhinostomy, and if unsuccessful, to progress to revision endonasal dacryocystorhinostomy and external dacryocystorhinostomy subsequently. Our flow chart for our patient pathway is shown in Figure 1.

It is described in the literature that a revision endonasal dacryocystorhinostomy has a high success rate of 82 per cent and still has a low rate of complications. As such, consideration for revision endonasal dacryocystorhinostomy would be advocated should a primary endonasal dacryocystorhinostomy be unsuccessful or partially successful. Should all these interventions be unsuccessful, then external dacryocystorhinostomy should be considered.[9,17,18]

Stent insertion as a primary intervention for congenital nasolacrimal duct obstruction has been the subject of a recent meta-analysis. This study concluded that there was a paucity of high-quality evidence, with only two randomised studies comparing stenting with other surgical interventions.[19,20] These randomised studies concluded that there was no statistical difference between stenting and probing alone (up to the age of 36 months) and that stenting was inferior to balloon dilatation in children over the age of 36 months. It is this reason, combined with the noted age difference between the successful endonasal dacryocystorhinostomy group and the successful probing and syringing group in our own study (2.68 *vs* 3.8 years), that led to our recommendation to change the management based on age, using three years as a cut-off. The study reviewed non-randomised studies but noted a wide variance in success rates, complication rates and practice with respect to type of insertion (mono *vs* bicanalicular) and duration of intubation (3 weeks to 12 months). Further studies also reviewed the use of stents following dacryocystorhinostomy. Sarode *et al.* showed no statistically significant improvement in success rates using silicone stents.[21] The dacryocystorhinostomy ostium following surgery appears to shrink within the first four weeks post-operatively but then remains stable in size up until two years.[17,18] It should be noted, however, that these studies all relate to adult practice. Our own data show that nasolacrimal stenting has a success rate comparable with that of probing and syringing alone. However, complications from nasolacrimal stent insertion have been reported frequently. Most commonly, these include stent migration leading to corneal abrasion. Some studies have reported complication rates as high as 48 per cent in children.[22–24] Given the comparable success rates of stent insertion to probing alone coupled with higher complication rates, we have recommended for stents to be considered only if a primary probing

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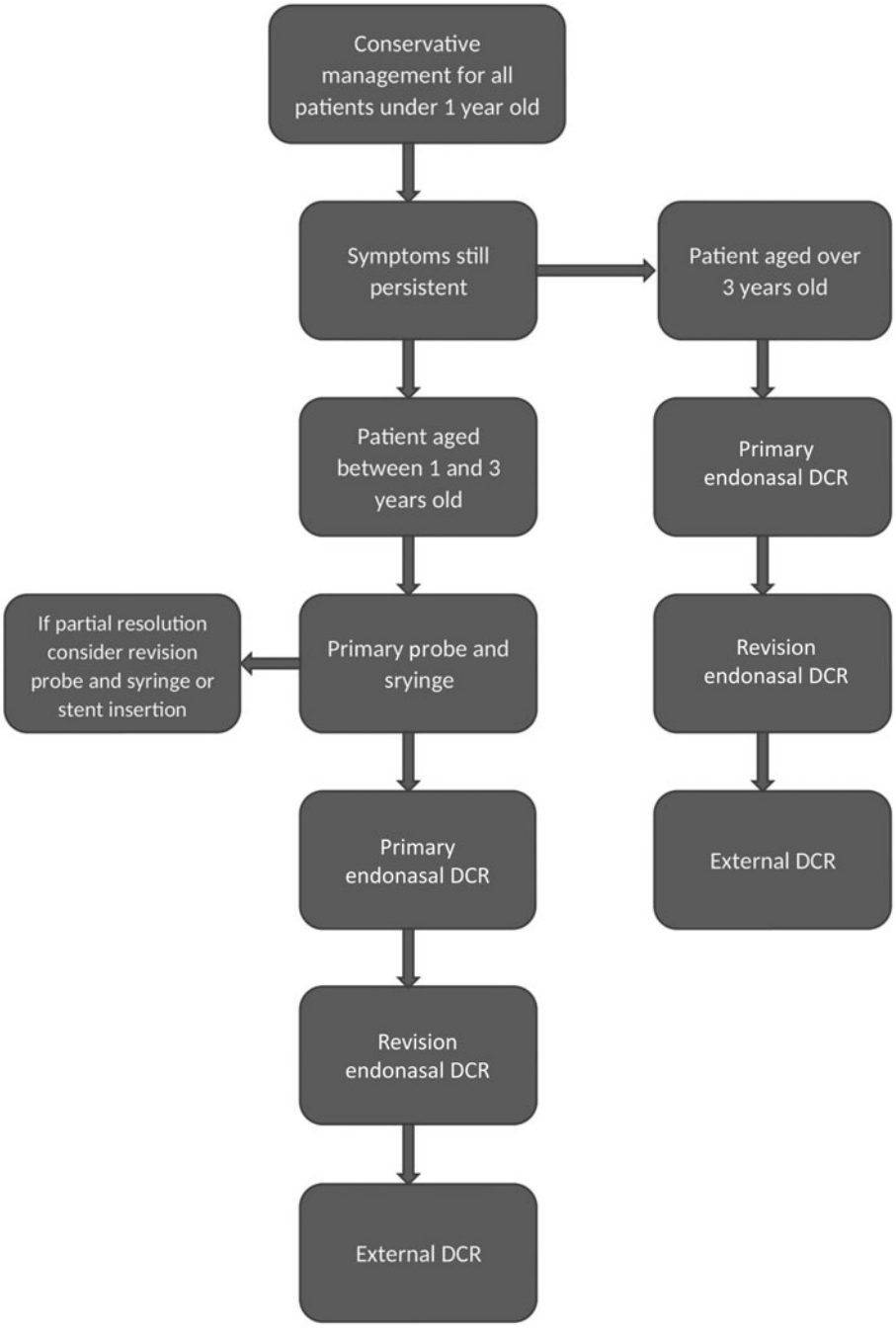

Figure 1. Patient pathway flow chart.
DCR = dacryocystorhinostomy

is partially successful and to be considered in conjunction with secondary probing alone.

- Nasolacrimal duct obstruction is a common condition affecting children, and multiple procedures have been described for the treatment of the condition
- Probing and syringing is the most commonly performed procedure and is shown to be effective
- Paediatric endonasal dacryocystorhinostomy is an effective and safe way of treating epiphora in both primary and revision cases
- This study proposed that children presenting under three years old should receive primary probing and syringing, and those over three years should receive a primary endonasal dacryocystorhinostomy

Twenty-seven of the procedures in this study were performed in patients with congenital syndromes. The most common ($n = 24$) were trisomy 21 patients. The other syndromes included branchio-oto-renal syndrome and facial dysmorphism. In this small group, probing and syringing appeared to be less successful, with a success rate of 50 per cent ($p < 0.05$). Primary dacryocystorhinostomy had a success rate of 80 per cent, although overall numbers were very low ($n = 5$). Further research is required to study the best method of treating syndromic children with epiphora and how this may differ from the treatment of non-syndromic children.

Conclusion

Congenital nasolacrimal duct obstruction is a very common condition in the paediatric population. If persistent, it can be effectively treated by nasolacrimal probing and syringing, stent insertion and dacryocystorhinostomy. Probing and syringing is the least invasive procedure but has a high rate of success, and as such, we advocate this intervention as the first surgical treatment of congenital nasolacrimal duct obstruction. Repeated probing and syringing does appear to reduce the success of other interventions, however, and as such, we advocate

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endonasal dacryocystorhinostomy for patients who have an unsuccessful probe and syringe. The rate of complications from dacryocystorhinostomy is low, and there were no long-term sequelae from either primary or revision endonasal dacryocystorhinostomy. More research is required into the maximal length of time for stents to remain in situ following endonasal dacryocystorhinostomy and how best to treat syndromic children with epiphora.

Competing interests. None declared

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