·Clinical Research·

Comparison of the extrusion rate of Crawford tubes

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Abstract

• **AIM: To compare the outcomes of dacryocystorhinostomy (DCR) using traditional Crawford tubes (TCT) and Crawford tubes with suture (CTS) in the lumen.**

• **METHODS: Retrospective case series consisting of patients who underwent DCR between 2008 and 2013.**

• **RESULTS: A total of 61 DCRs were performed on 50 patients. Patients who underwent DCR using CTS had higher rates of prolapse compared to the TCT group (50% *vs* 9.4%; *P*=0.003). Stent removal occurred earlier in patients who received CTS (3.3mo *vs* 5.1mo; *P*= 0.004). Success rates were equivalent between the two groups (75% *vs*81.1%; *P*=0.684).**

• **CONCLUSION: CTS in the lumen increases the risk of prolapse, prompting earlier tube removal in patients following DCR for nasolacrimal duct obstruction (NLDO). Earlier removal of tubes does not appear to significantly decrease success rates.**

• **KEYWORDS:** nasolacrimal duct obstruction; dacryocystorhinostomy; dacryocystitis
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INTRODUCTION

Dacryocystorhinostomy (DCR) is a procedure commonly performed in patients with nasolacrimal duct obstruction (NLDO)[1-5]. As part of the procedure, silicone stents-most commonly Crawford tubes at our institution-are inserted into the drainage system with the goal of maintaining patency of the newly created fistula. Crawford tube with suture (CTS) in the lumen is an alternative intubation tool that can be useful for patients in whom in-office removal of tubes poses challenge [6-8]. As described by Crawford [6], CTS placement involves stripping the distal silicone ends of the tubing and tying sutures to make a continuous loop in the nose. In this study, we will compare the outcomes of DCR using traditional Crawford tubes (TCT) and CTS.

SUBJECTS AND METHODS

Subjects A retrospective chart review was performed on all patients who underwent DCR at NewYork-Presbyterian Hospital (NYPH) between the 2008 and 2013 academic years. Charts were culled for demographic information including age at time of surgery, gender, and etiology of NLDO. Additional investigative parameters included type of DCR (external *vs* endoscopic), history of previous lacrimal surgery, and any concomitant sinus surgery. Choosing the specific approach was based primarily on patient preference following extensive discussion of the advantages and disadvantages of each. Of note, all endoscopic cases were performed jointly with colleagues from the Department of Otolaryngology (ENT), as is customary practice at our institution. Patients included in the study were compared based on the type of silicone intubation tube used-specifically CTS or TCT. As the study was retrospective, patients were not randomized to a specific type of tubing. Institutional Review Board (IRB) approval was obtained and investigations were performed according to the Declaration of Helsinki.

Main Outcome Measures The main outcome measures in this study included incidence of prolapse, time to tube removal, and failure of surgery. Prolapse was determined either by history-namely, patients reporting tube protrusion from the canaliculi-or by exam. Repositioning of the prolapsed tube was attempted prior to removal in all patients. Determination of failure depended on the etiology of NLDO. If DCR was performed for dacryocystitis, the procedure was considered a failure if the infection recurred post-operatively. On the other hand, if epiphora was the primary surgical indication, outcome was deemed a failure if the post-operative course warranted revision or repeat surgical intervention or if the patient did not report any improvement in tearing. Lacrimal probing and irrigation was used throughout the post-operative course to assess patency. Stents were removed according to clinical course, with planned removal time ranging from 2-12mo, as previously reported[9]. The time from date of surgery to latest visit on record was used to determine length of follow-up.

Statistical Analysis Data analysis was performed with Chi-square testing of association and Student's two-tailed *t*-test when appropriate. All statistical analysis was performed

using Excel (Microsoft, Redmond, Washington, USA). $P<0.05$ were considered statistically significant.

RESULTS

A total of 61 DCRs were performed on 50 patients. Average age of patients was 39 (2-71) in CTS and 52 (29-87) in the TCT group (P=0.124). In CTS and TCT groups respectively, 70% and 73% of patients were female (P =0.677). Thirty-eight cases were performed endoscopically, and 23 were performed using the external approach. Eight cases were performed using CTS while the remaining 53 were performed using TCT. In both the TCT and CTS cohorts, the primary indication for surgery was epiphora. Twelve patients (22.6%) in the TCT and one (12.5%) in the CTS groups had DCR performed for dacryocystitis. One patient (1.8%) underwent external DCR with TCT for intranasal melanoma with concomitant excision and reconstruction. Concomitant sinus surgery was performed in 25% and 43.5% of patients in the CTS and TCT groups respectively (P=0.280). There was no significant difference in preoperative characteristics between the two groups (Table 1).

Patients who underwent DCR using CTS had higher rates of prolapse compared to the TCT group (50% *vs* 9.4%; P= 0.003). In this cohort, time to tube removal varied widely from 6 to 757d. Stent removal occurred earlier in patients who received CTS, and the difference in time to stent removal reached statistical significance (3.3mo *vs* 5.1mo; P=0.004). Average length of follow-up was similar between the two groups (12.7mo *vs* 13.5mo; P=0.873).

Though Crawford tubes were removed earlier in patients with CTS, this did not affect success rates between the two groups (75% *vs* 81.1%; P=0.684). In addition, the incidence of failure in those with tube prolapse and those without was not statistically significant (P=0.264). Average length of follow-up time did not differ significant between groups (P=0.873; Table 2).

Table 1 Preoperative characteristics for patients undegoing DCR for NLDO %

Approaches	Surgical Indication (epiphora)	Type of DCR (endoscopic)	Previous lacrimal surgery
CTS	87.5	62.5	50
TCT	75.5	62.3	30.2

Table 2 Postoperative results in patients undergoing DCR for NLDO using the CTS and TCT approaches

Approaches	Prolapse (%)	Success (%)	Average time to Tube removal (mo)	Average time to follow-up (mo)
CTS	50	75	3.3	12.7
TCT	9.4	81.1	5.1	13.5

DISCUSSION

The technique of DCR, first described by Toti[10] in 1904, was further evolved by Dupuy-Dutemps and Bourguet [11] in 1921. DCR is performed to treat the clinical sequelae of NLDO, including epiphora and dacryocystitis, as well as for the reconstruction of the nasolacrimal system following trauma or excisional surgery. The procedure has been further refined and enhanced to include endoscopic approaches and silicone intubation systems.

Lateral prolapse of Crawford tubes is one of the most common complications of using silicone intubation [12]. A literature review performed by Brookes and Olver [13] cite the incidence of tube prolapse after DCR between 1.5%-14%. Risk factors for prolapse include lower lid laxity, low knot position, and the type of tie used[14]. Lateral prolapse of tubing is problematic due to the potential for corneal and conjunctival irritation, punctal erosion, and patient discomfort. Concern for or development of these complications on the part of the patient and surgeon often leads to premature tube removal [15,16]. Various mechanisms to reposition the tubes have been reported, including simple mechanical replacement, pulling the ends back into the nose under endoscopic guidance, and the application of clips to provide further security.

In our study, the rate of tube prolapse was significant higher when CTS was used, relative to the traditional method. Although the sample size was small (n =8), the rate of prolapse was 50% in this population of patients. On the other hand, the prolapse rate was 9.4% when the traditional Crawford tube method was implemented, which aligns more closely with the numbers reported in the literature. Although repositioning was attempted for all patients, it was unsuccessful in all but 3 cases, necessitating removal of silicone tubing at the time of prolapse. In one case, a patient cut and removed the tubing at home following prolapse. We hypothesize that the mechanism of prolapse is related to the decreased length of the rigid tubing in CTS following stripping of the silicone prior to tying the tube in the nose. The decreased length of rigid tubing may increase mobility of the tubes and thus predispose them to prolapse.

One case of unilateral prolapse in our study occurred in a 2-year-old patient who underwent bilateral endoscopic DCR for primary NLDO. While the high rate of tube prolapse in children is well-documented-Dortzbach and Angrist [17] reported a rate of 17.5% , Abdu and Salisu [18] reported similarly (17.6%) -even if we exclude this child from our analysis, the rate of prolapse still remains 50% when DCR is performed with CTS.

Interestingly, the overall success rates were not significantly different between the two groups despite the frequency of earlier tube removal seen in the CTS group. Although earlier removal might theoretically prohibit complete epithelialization of the lacrimal passage, this has not been definitively proven in studies examining this topic. For instance, Vicinanzo *et al*[9] examined success rates in patients with tube extrusion before planned removal at 2mo. In their cohort of 233 cases, while the early extrusion group exhibited slightly lower success rates (90.5% *vs* 94.9%), this difference was not statistically significant. Similarly, in our cohort, those patients who underwent tube removal prior to 2mo were more likely to fail DCR (25% *vs* 13%), but this difference did not reach significance (P=0.266).

The authors typically use 3-4mo as goal time for planned tube removal. Though no consensus exists for ideal time for

tube removal, it is thought that the majority of healing has occurred by this time and therefore additional scarring or fibrosis is unlikely to occur later. Tubes may be removed earlier if patients are experiencing punctal erosion, if they have ocular allergy or irritation to the tube or the tube prematurely prolapses. Tubes are left in place or removed later if symptoms are resolved but patients demonstrate severe ocular allergy or concomitant nasal or sinus disease.

Of note, there is great debate in the literature on whether silicone stents provide enough of an improvement in outcome to justify their use. In a recent randomized clinical study of 120 patients, Chong *et al* [19] concluded that there was no difference in success rates when patients were randomized to receive or not receive stenting. Mohamed *et al* [20] found a higher long-term success rate (89% *vs* 57%) in those patients who were not stented, although this study was retrospective in nature. Additionally, two separate Meta-analyses demonstrated no significant benefit for silicone tube intubation in primary DCR [21,22]. In contrast, Vishwarkarma *et al* [23] performed a study comprised of 272 patients that demonstrated improved outcomes with endoscopic DCR plus stenting when compared to both the external approach and endoscopic DCR without stenting. Debate continues in this area and research studies are ongoing.

While strong trends in our data appear to be present, there are also significant limitations that must be acknowledged. Notably, the sample size of our CTS group was small, which may limit the ability to detect statistical significance in our comparative study. In addition, the inherent limitations of the retrospective nature of this study may also limit the power of the analysis. Furthermore, given that CTS was preferentially used in patients for whom in-office removal of tubing was predicted to be difficult, our own selection bias may have affected the study results.

Our results show that CTS in the lumen increases the risk of prolapse, prompting earlier tube removal in patients following DCR for NLDO. However, earlier removal of tubes does not appear to significantly decrease success rates and leaves open the possibility that Crawford tubes with suture can be used in patients for whom in-office removal of tubing is predicted to be difficult without compromising their ultimate surgical outcome.

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