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Original Article

Determination of the function of a repaired canaliculus after monocanalicular injury by placing a punctal plug in the non-involved punctum on the affected side

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Abstract

Background: To determine whether repair of a monocanalicular laceration using a Mini-Monoka stent provides a functioning system.

Methods: This prospective study included patients who underwent repair of a monocanalicular laceration with placement of a Mini-Monoka stent. Silicone punctal plugs were placed in the unaffected punctum on the side that had sustained the injury and in the same punctum on the fellow eye. The plug was left in place for between 7 and 17 days. The patient was questioned after placement regarding symptoms of epiphora.

Results: Eight patients were included in the study; five injuries involved the lower canaliculus, two the upper, and one the upper and lower but only the lower was repaired. Of injuries, 50% were as a result of assault. Seven out of eight patients had no epiphora from the repaired eye during plug placement. One patient complained of significant epiphora from the repaired eye during the time the plugs were placed; this patient had a partial nasolacrimal duct obstruction and no canalicular stenosis. Of patients, 88% had an anatomically patent canaliculus and 100% were tearing-free when no plug was placed.

Conclusions: In this study, a repaired monocanalicular injury provided a functioning system in 88% of cases. In previous studies, it has been shown that many patients are symptom-free with just one functioning canaliculus. However, a fully functioning canalicular system may help to prevent tearing under stress conditions, and will provide a viable system if the other canaliculus is irreparably damaged in the future. Therefore, repair is recommended.

Key words: canalicular laceration, canalicular repair, Mini-Monoka, punctal plug.

Introduction

Monocanalicular repair has been reported with varying anatomical and functional success rates. It is, however, possible for normal tear drainage to occur with only one functioning canaliculus.[1] It is therefore difficult to gauge whether or not a repaired patent canaliculus is functioning. This study investigates whether a repaired canaliculus provides adequate drainage when the fellow punctum is occluded using a silicone punctal plug.

Methods

This prospective study was performed over a 1-year period from April 2007 to May 2008. Patients were recruited who had previously undergone repair of a monocanalicular laceration with placement of a Mini-Monoka stent during March 2006 to March 2007. The study was conducted in accordance with good clinical practices and with the Declaration of Helsinki 2000 and patient confidentiality was maintained. New Zealand Health and Disability Ethics Committee approval was obtained. Patients

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were given informed consent and had the option to not participate in the study.

The patients underwent repair of monocanalicular injuries by three different surgeons, but under the care of a single consultant oculoplastic surgeon (PR). A Mini-Monoka stent was placed in the lacerated canaliculus and the canaliculus was repaired using two to three 8-0 Vicryl sutures on a tapered needle. The medial canthal tendon was repaired with one to two 6-0 Vicryl sutures on a spatulated half-circle needle.

The stent was placed in the lacerated canaliculus; this was removed at a mean duration of 8 months after surgery. The patient's nasolacrimal system was syringed either immediately after removal of the Mini-Monoka stent or immediately after removal of the silicone plugs to confirm anatomical patency of the canaliculus. The largest-sized silicone plug that would sit comfortably was placed in the unaffected punctum on the side that had sustained the injury and another in the same fellow punctum. The punctal plug was left in place for between 7 and 17 days; before removal, it was documented whether the punctal plugs were still *in situ* in both punctums. The patient was questioned after placement of the plugs regarding any symptoms of epiphora.

Table 1. Characteristics of patients, injury and repair outcomes

Characteristics	Number
All patients with a canalicular laceration repair during the study period ($n = 11$)	
Male : female	8:3
Mean age (range)	33 (10–52) years
Lower canaliculus laceration (%)	$n = 8$ (72.7%)
Upper canaliculus laceration (%)	$n = 2$ (18.2%)
Upper and lower canalicular laceration (%)	$n = 1$ (9.1%)
Mean duration of stent (range)	7 (5–12) months
Premature stent extrusion (%)	0%
Patients in study ($n = 8$)	
Male : female	6:2
Mean age (range)	36 (20–52) years
Lower canaliculus laceration (%)	$n = 5$ (62.5%)
Upper canaliculus laceration (%)	$n = 2$ (25%)
Upper and lower canalicular laceration (%)	$n = 1$ (12.5%)
Mean duration of stent (range)	8 (5–12) months
Premature stent extrusion (%)	$n = 0$ (0%)
Patients experiencing no epiphora after placement of punctal plugs in opposite punctum of injured eye (%)	$n = 7$ (87.5%)
Patients experiencing no epiphora after placement of punctal plugs in fellow punctum of non-injured eye (%)	$n = 8$ (100%)
Overall anatomical canalicular patency (%)	$n = 7$ (87.5%)
Overall functional success when plugs are not in place (%)	$n = 8$ (100%)

Results

During the 1-year study period, 11 patients underwent a canalicular repair (see Table 1). Of these, eight patients were included in the study. Of the three not included, one patient was abroad, one was 10 years old and the last could not tolerate the fitting of punctal plugs. Six of the study patients were male and two female, with a mean age of 36 (range 20–52) years. Five were right eyes and the remaining three were left. Five injuries involved the lower canaliculus, two the upper, and one involved both the upper and lower but only the lower was repaired because of difficulties in repairing the upper (Table 1). Of injuries, 50% were as a result of assault; these patients were all male. Of the remaining, one was due to a rugby injury and the other three were accidents.

The Mini-Monoka stents remained in place for an average of 8 (range 5–12) months. No stents were displaced or spontaneously lost; all were removed in clinic. The authors' aim was to remove all the stents at 7 months, the premise being that leaving the stent *in situ* over this period should allow for completion of the healing process and reduce scar contracture closing off the repaired canaliculus. However, this was not always possible because of clinic booking pressures and patient factors.

The silicone punctal plugs were put in place on the day of stent removal in five patients, 1 month later in one, 2 months in another and 8 months later in the final patient. The three patients who had punctal plugs placed 1–8 months after surgery were recruited on their follow-up visit after Mini-Monoka stent removal. The plugs were left in place between 7 and 17 days. On return for removal, all of the silicone plugs were still in place except one patient whose plug had fallen out of the non-repaired eye. It was unknown when the plug was lost. This patient had no epiphora during the study from either eye. Of patients, 88% had no epiphora from the repaired eye and 100% had no epiphora from the undamaged eye during the placement of punctal plugs. One patient complained of significant epiphora from the repaired eye during the time the plugs were in place; the fellow eye was asymptomatic. On syringing of the repaired canaliculus, no canalicular stenosis or obstruction was noted and there was saline to the throat but some reflux from the opposite punctum. This indicates that the canalicular system was anatomically patent but that there may have been a partial nasolacrimal duct stenosis. On syringing of the others, one patient had partial canalicular stenosis of the repaired canaliculus; saline did pass to the patient's throat. Furthermore, the patient with partial canalicular stenosis experienced no problems with watering when the silicone plugs were in place.

Discussion

The majority of patients in our study were male; this predominance has previously been reported.[2,3] The study by Jordan *et al.*, of canalicular injury in 236 patients, found that 52% of injuries involved only the lower canaliculus and 32% the upper canaliculus; involvement of both is more unusual (14%).[4] This is similar to the current study; 62.5% had lower canalicular involvement, 25% upper and 12.5% upper and lower. They also found that direct injury (54.2%) compared with avulsion was the most common type of injury.[4]

A limitation of the current study is the small number of patients included compared with previous studies such as the study by Kennedy *et al.* of 222 patients.[3] Varying success rates have been reported regarding anatomical and functional patency post-canalicular repair. Kennedy *et al.* found that after canalicular repair, stress or constant epiphora occurred in 61.5% who had had both upper and lower canalicular injuries, compared with 19.7% in those with only one canaliculus involved.[3] However, other studies have shown that many patients are asymptomatic after obstruction of one canaliculus.[1,2] The study by Smit *et al.*, of 13 patients with monocanalicular injuries repaired without re-anastomosis of the lacerated canaliculus resulting in total canalicular obstruction, reported that no patients complained of inconvenient tearing either indoors or outdoors.[1] Although three patients experienced tearing outside only in cold and wind. It is therefore difficult to determine whether repair of the lacerated or avulsed canaliculus is providing a functioning system. A previous study calculated, using the drop test, that the maximal outflow capacity does reduce if one punctum is occluded; however, this level is still much higher than normal basal tear production.[5] Murgatroyd *et al.* suggest that the capacity of the common canaliculus may limit flow along two patent canaliculi, thus allowing increased flow along a patent canaliculi when the other is occluded.[5] Because of this, some authors have advocated not repairing a monocanalicular injury; a survey of UK consultants with an oculoplastics' interest reported that only 40% would always repair a moncanalicular injury.[6] The current study indicates through plugging of the opposite punctum that the repaired canaliculus still provides a functioning system.

All of the patients in this study had a monocanalicular stent placed during repair. It is important to place a stent during canalicular repair; in an animal study, it was found that stenting was important to re-establish canalicular patency.[7] Kennedy *et al.* commented that epiphora was significantly more likely to occur when no canalicular stent had been placed; in addition, epiphora was more common in adults than in children and in those where a pigtail probe had been used.[3] There is no consensus over the amount of time a stent should remain in place. An animal study that reviewed removal of stents at 4, 8 or 12 weeks found that the optimum time for removal was 12 weeks.[7] Kersten left stents in for 3 months and recorded patent probing rates of 100%.[8] Naik *et al.* recorded a 90% anatomical and 100% functional success rate after leaving Mini-Monoka stents in for a mean duration of 15.2 weeks.[2] In this study, the stents were left in place for a mean time period of 8 months leading to an 88% anatomical and 100% functional success rate. No stents in this study extruded prematurely. In previous studies, rates of 11.1–43.7% premature Mini-Monoka stent loss have been recorded.[2,9,10] The study recording a stent loss rate of 43.7% was using the stent in cases of congenital nasolacrimal duct obstruction and these patients often removed the stents themselves.[9]

This study has shown that a repaired monocanalicular injury provides a functioning system in 88% of cases. The patient that watered during plug placement had a partial nasolacrimal duct obstruction and no canalicular stenosis. Repair of a monocanalicular laceration is achievable and the use of a Mini-Monoka stent does not compromise the other canaliculus. Although in previous studies it has been shown that many patients are symptom-free with just one functioning canaliculus, some are not, particularly when the lacrimal drainage system is placed under stress. A functioning canaliculus may help to prevent tearing under such conditions, and will also provide a viable system in the unlikely situation that the other canaliculus is irreparably damaged in the future.

In conclusion, canalicular repair is safe and effective and repair should be attempted in either upper or lower system injuries.

References

1. Smit TJ, Mourits MP. Monocanalicular lesions to reconstruct or not. *Ophthalmology* 1999; **106**: 1310–12.
2. Naik ML, Kelapure A, Rath S, Honaver S. Management of canalicular lacerations: epidemiological aspects and experience with Mini-Monaka monocanalicular stent. *Am J Ophthalmol* 2008; **145**: 375–80.
3. Kennedy RH, May J, Dailey J, Flanagan JC. Canalicular laceration. An 11-year epidemiologic and clinical study. *Ophthal Plast Reconstr Surg* 1990; **6**: 46–53.
4. Jordan DR, Ziai S, Gilberg SM, Mawn LA. Pathogenesis of canalicular lacerations. *Ophthal Plast Reconstr Surg* 2008; **24**: 394–8.
5. Murgatroyd H, Craig JP, Sloan B. Determination of relative contribution of the superior and inferior canaliculi to the lacrimal drainage system in health using the drop test. *Clin Experiment Ophthalmol* 2004; **32**: 404–10.

6. Ho T, Lee V. National survey on the management of lacrimal canalicular injury in the United Kingdom. *Clin Experiment Ophthalmol* 2006; **34**: 39–43.
7. Conlon MR, Smith KD, Cadera W, Shum D, Allen LH. An animal model studying reconstruction techniques and histopathological changes in repair of canalicular lacerations. *Can J Ophthalmol* 1994; **29**: 3–8.
8. Kersten RC, Kulwin DR. 'One-stitch' canalicular repair. A simplified approach for repair of canalicular laceration. *Ophthalmology* 1996; **103**: 785–9.
9. Kaufman LM, Guay-Bhatia LA. Monocanalicular intubation with Monoka tubes for the treatment of congenital nasolacrimal duct obstruction. *Ophthalmology* 1998; **105**: 336–41.
10. Anastas CN, Potts MJ, Raiter J. Mini Monoka silicone monocanalicular lacrimal stents: subjective and objective outcomes. *Orbit* 2001; **20**: 189–200.