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Surgical corrections and postsurgical complications of epiglottic entrapment in Thoroughbreds: 12 cases (2009–2015)

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Twelve Thoroughbred racehorses were diagnosed as epiglottic entrapment at the Korea Racing Authority equine hospital. Four different surgical correction techniques were used to treat epiglottic entrapment: the transnasal hook bistoury, transoral unshielded hook bistoury, transnasal shielded hook bistoury, and transendoscopic laser techniques. Eleven cases were surgically resolved eventually, with one case of recurrence. Five complications related to surgical correction occurred: a severe nasal passage laceration and bleeding (n=1), epiglottic laceration (n=1), epiglottis tip burns (n=2), and moderate nasal passage laceration (n=1). Intraoperative complications occurred in approximately 41.7% of cases. Thus, the possibility of surgical complication should be considered thoroughly when choosing a surgical technique for correction of epiglottic entrapment.

Key words: *axial division, epiglottic entrapment, shielded hook bistoury, Thoroughbred*

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Epiglottic entrapment in horses, first reported in 1978 [5], is a respiratory disorder arising as the result of an edematous and/or hypertrophied aryepiglottic fold and subepiglottic mucosa enveloping the epiglottis dorsally [5, 6, 10]. In epiglottic entrapment, the normal vascular pattern and notched edge of the epiglottis cannot be seen due to a retroverted aryepiglottic fold and the involved mucosa [6, 7]. Epiglottic entrapment can occur persistently or intermittently and is primarily a respiratory disorder of athletic horses [4, 7]. Affected horses commonly present with abnormal respiratory noise and exercise intolerance [6, 10].

Surgical treatments are primarily recommended for correcting epiglottis entrapment [7]. Various surgical techniques have been described, and postoperative recurrence rates are diverse and depend on the surgical method [1, 7, 8]. Recurrence rates are reported to be 5–15% after transnasal axial division with unshielded/shielded bistoury, 10% after transoral axial division with unshielded bistoury, and 4% after laser axial division, whereas a relatively high (40%) recurrence rate has been reported after transendoscopic electrosurgical axial division, and a similarly high 36% rate has been reported after resection via laryngotomy [2, 7].

This report describes 12 epiglottic entrapment cases that were treated by using surgical techniques previously associated with a low recurrence rate. The purpose of this study was to investigate the prognosis and intraoperative complications associated with epiglottic entrapment depending on the surgical method used. The results of this study may help equine practitioners select an appropriate surgical technique for treatment of epiglottic entrapment.

Between April 2009 and April 2015, respiratory endoscopic examinations were conducted in 975 horses at the Korea Racing Authority equine hospital, and12 Thoroughbred racehorses were diagnosed as having epiglottic entrapment. The affected horses presented abnormal respiratory noise on exercise and reduced athletic performance according to their owners. The horses' conditions were diagnosed after performing at least two presurgical resting endoscopic examinations of the upper respiratory tract. Retrieved data included history, endoscopic examination results, surgical technique, intraoperative complications, prognosis, and performance results.

After epiglottic entrapment diagnosis, one of four surgical techniques was applied to correct the entrapped epiglottis: axial division with transnasal hook bistoury (2 cases), axial division with transoral hook bistoury (1 case), axial division with transnasal shielded hook bistoury (4

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cases, including 1 re-surgery), or axial division using a transendoscopic laser (5 cases, including 1 re-surgery). A commercial hook bistoury (Equine Epiglottic Entrapment Knife, Sontec Instruments) was used in both transnasal and transoral axial division, and a flexible fiber diode laser instrument (Ceralas D25, Biolitec AG) was used in transendoscopic laser axial division. A power setting of 15–18 W was used when the laser instrument was used in contact fashion. The surgeon chose the appropriate surgical technique depending on surgeon preference, experience, and instrument availability. Most patients were operated on via standing surgery under sedation with detomidine (0.02 mg/kg) and butorphanol (0.10 mg/kg). As a topical anesthetic, 50 ml of 2% lidocaine was sprayed on the epiglottis. However, intravenous ketamine (2.20 mg/kg) was used to induce general anesthesia for axial division with transoral hook bistoury. Intramuscular procaine penicillin G (20,000 IU/kg) and intravenous flunixin meglumine (1.10 mg/kg) were administered for 5 days postoperatively. All horses were endoscopically re-examined to evaluate their epiglottis status at two weeks after operation. For each horse, elapsed time from surgery to first race (days), rank in the last race before surgery, and rank in the first race after surgery were obtained from race records from an online Korea Racing Authority database: http://studbook.kra.co.kr/. The performance results for each completed surgical epiglottic entrapment case were included, whereas the performance result for the sole uncompleted surgical case was excluded.

During the 6-year study period, 975 horses underwent endoscopic examination of the upper respiratory tract, and 12 horses were diagnosed as having epiglottic entrapment, indicating an epiglottic entrapment incident rate of 1.2%. Eight horses were male (including stallions and geldings) and four horses were female. The horses' ages ranged from 2 to 6 years (mean age 3.8 years). Ulcerations of the entrapped mucous membrane were observed in five of the twelve cases (41.7%). Among the 12 horses with epiglottic entrapment, there were 14 surgical trials, including 2 re-surgeries. Correction of epiglottic entrapment was successfully completed in 11 horses. However, one surgical trial with a transnasal bistoury was not completed due to severe nasal passage laceration with bleeding. Eleven horses underwent axial division surgery, and all were Thoroughbred horses undergoing training.

Major and minor complications occurred in 5 (41.7%) of the 12 horses that underwent epiglottic entrapment surgery. Major complications involved severe nasal passage laceration and partial laceration of the epiglottis (n=2, 16.7%). Minor complications included moderate nasal passage laceration (n=1, 8.3%) and laser-burned epiglottis (n=2, 16.7%). The severe nasal passage laceration was due to unexpected horse movement during insertion of the hook bistoury through the nasal passage; the consequent bleeding lasted 2 days and caused severe anemia (RBC, 4.1×10^6 μl; PCV, 16%). The horse's owner refused further surgery to correct the epiglottic entrapment. The partial laceration of the epiglottis occurred incidental to swallowing during axial division of entrapped mucous (Fig. 1). The intraoperative moderate nasal passage laceration occurred due to unexpected retraction of the unclosed shield bistoury from the laryngopharyngeal cavity. In that case, the surgery with an unclosed shield bistoury was stopped, and re-surgery was performed with a transendoscopic laser. Epiglottis tip burns occurred in two (40.0%) of the five horses treated with transendoscopic laser surgery, including one re-surgery case. Of the five surgery cases with transnasal shielded bistoury, re-surgery was required to correct one re-entrapment observed during postoperative endoscopic examination (Table 1). Excluding the one re-entrapment, which occurred with the transnasal shielded hook bistoury approach, no

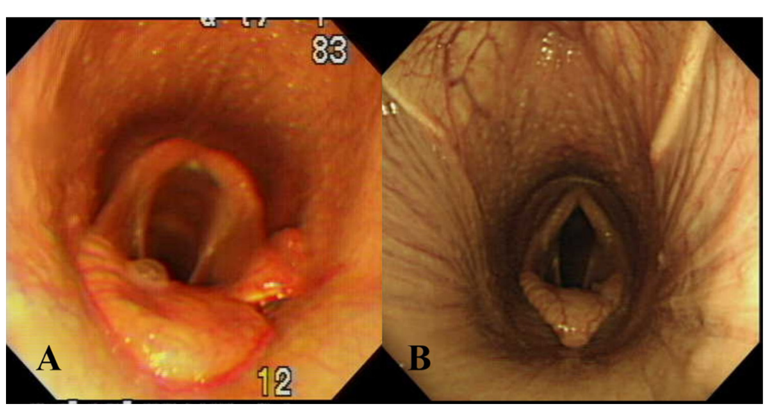

Fig. 1. Image of intraoperative complication following transoral axial division with hook bistoury. (A) Partial epiglottis laceration due to swallowing during axial division. (B) Healed epiglottis at postoperative endoscopic examination after 2 months.

other cases of epiglottic entrapment had recurred by the two-month postoperative endoscopic examination. Additional intensive care was needed in the severe laceration case, and, in that case, both nasal passage lacerations were eventually resolved. The partial epiglottis laceration was resolved via secondary healing over an estimated recovery time of two months. The epiglottis tip burns were not visible at 2 weeks after laser surgery.

The mean time to the first race start was 115 days in transoral hook bistoury-based surgery (1/11), 74 days in transnasal hook bistoury-based surgery (1/11), 69 days in transnasal shielded hook bistoury-based surgery (4/11), and 109 days in transendoscopic laser-based surgery (5/11) (Table 2). The mean race rank for the case horses in the last race prior to surgery was 0.8 (range 0.3–1.0), whereas the mean race rank in the first postoperative race was surgery was 0.6 (range 0.2–1.0) (Table 3).

Epiglottic entrapments is related to intensive exercise

Table 1. Re-surgery and complications of epiglottic entrapment surgery in twelve horses

Case	Age	Technique	Re-surgery	Complications
1	3	TL		
2	5	TL		
3	3	TL		
4	6	TL		Epiglottis tip burn
5	5	TSHB		
6	3	TSHB		
7	4	TSHB		
8	4	TSHB	TSHB*	
9	3	TSHB (uncompleted)	TL**	Moderate nasal passage laceration at TSHB and epiglottis tip burn at re-surgery with TL
10	3	ToHB		Partial epiglottis laceration
11	4	TnHB		
12	2	TnHB*** (uncompleted)		Severe nasal passage laceration

TL, Transendoscopic laser; TSHB, Transnasal shielded hook bistoury; ToHB, Transoral hook bistoury; TnHB, Transnasal hook bistoury. *Epiglottis entrapment was resolved by transnasal axial division using a shielded hook bistoury in both first and second surgeries in the same horse. **First surgical trial did not completed due to unclosed shielded hook bistoury and re-surgery with transendoscopic laser technique was operated. ***Transnasal hook bistoury technique was applied, but was not completed due to a severe nasal passage laceration with bleeding while inserting a hook bistoury through nasal passage.

Table 2. Elapsed time from surgery to first race categorized by epiglottic entrapment surgical technique

Surgical techniques	Transoral hook bistoury	Transnasal hook bistoury	Transnasal shielded hook bistoury	Transendoscopic laser
Number of horses	1*	1	4	5
Mean time to 1st race start (day)	115	74	69	109
- Minimum (day)	115	74	52	189
- Maximum (day)	115	74	89	65

*One case was excluded from the transoral bistoury group with severe nasal passage laceration complication because of owner's refusal of re-surgery.

Table 3. Changes in pre-surgery and post-surgery race ranking of cases surgically treated for epiglottic entrapment

Race record	Last race pre-surgery	First race post-surgery
Number of horses	11*	11*
Mean rank rate (rank/runners)	0.8	0.6
- Highest (rank/runners)	0.3	0.2
- Lowest (rank/runners)	1	1

*One horse in the transoral bistoury group with severe nasal passage laceration complication was excluded because of owner refusal of re-surgery.

and occurs in Thoroughbred and Standardbreds horses, but it rarely occurs in old horses and other breeds [7, 13]. In the present study, all affected horses were relatively young Thoroughbreds (average age: 3.8 years) undergoing exercise-based training. Occurrence of this upper respiratory disorder, epiglottic entrapment, was rare (incidence rate: 1.2%, 12/975), and the rate was similar to rates reported previously [12, 14].

To date, transnasal, transoral, and transendoscopic resolutions have been accepted treatments for the correction of epiglottic entrapment [6], and these approaches are able to produce comparable outcomes [4]. Four different surgical techniques were applied to correct the epiglottic entrapments in these cases, and each surgical method was chosen based on the preference, experience, skill of the clinicians, and equipment availability. Postoperatively, normal epiglottis function was eventually restored in all cases. The hook bistoury *per nasum* procedure has the advantages of short surgery time and inexpensiveness [3, 11], although there is high risk of iatrogenic damage to soft tissues [3, 6, 7, 11]. While the risk associated with the complication of a cleft soft palate was emphasized in previous reports [2, 6], nasal passage laceration due to uncooperative horse head movement resulted in severe anemia in one case. To reduce iatrogenic damage and improve ease of bistoury manipulation, hook bistoury *per os* was introduced [11]. The transoral bistoury-based procedure requires a surgeon's hand to approach the caudal part of the oral cavity [2]. In a situation with a large hand and a narrow oral cavity, surgery can be difficult to perform [2]. In a transoral procedure case, an oral approach in lateral recumbency under general anesthesia was performed, and partial epiglottis laceration occurred due to the horse swallowing during bistoury-based axial division. Therefore performing transoral surgery on a horse in lateral recumbency under general anesthesia was required an abundance of clinician experience in this case.

The transendoscopic laser technique is relatively safe, but expensive specialized equipment and sufficient clinician experience are required; moreover, the procedure time is relatively long [3, 6, 11]. A common complication of the laser-based technique is iatrogenic trauma to the epiglottis [6]. Use of bronchoesophageal grasping forceps transnasally to elevate the entrapping membrane away from the epiglottis can provide the benefit of reducing the iatrogenic trauma [8]. Among the five laser-based procedure cases in this study, there were two cases of iatrogenic burn on the epiglottis tip. Thus, a sufficient level of experience and precision with laser equipment is required to obtain an acceptable outcome. In 2011, the shielded hook bistoury was invented for use in equine veterinary practice [10]. Its advantages are a reduced risk of iatrogenic injury, short surgery time, and ease of operation [10]. In one case in this study, an unexpected intraoperative complication occurred due to an unclosed bistoury shield, leading to moderate damage of the nasal passage during withdrawal. An unclosed shield occupies more space vertically, so its withdrawal through the nasal passage is difficult and injurious. Regardless, the shielded hook bistoury technique seems to be the most suitable of the surgical techniques applied in this study, as long as a preoperative instrument function check is carried out. The observations and results of this study suggest that treatment of epiglottic entrapment via transnasal axial division with a shielded hook bistoury is quick, facilitative, and inexpensive and can produce relatively mild complications.

The reported recurrence rate of epiglottic entrapment is within the approximate range of 4% to 15%, with re-entrapment occurrence dependent on the surgical approach [2]. The time from operation to return to race training is generally recommended to be approximately 4–6 weeks with a gradual rehabilitation procedure [9]. To reduce early re-entrapment and allow resolution of inflammation, rest during postoperative weeks 2–3 has been recommended [9]. In the present cases, the re-entrapment rate (9.1%) was similar to that in a previously report [2]. Based on this result, it appears that most horses in this study had sufficient rest (minimum rest period: 52 days, Table 2) before returning to race training to facilitate recovery from inflammation and to prevent re-entrapment.

The case that underwent the transoral procedure needed the longest time from the surgery to first race start (115 days) due to the time needed to resolve the partial epiglottis laceration. The laser-based procedure cases also required a long time to first race start after surgery, a mean of 109.2 days, due to iatrogenic damages on the epiglottis. Thermal damage during the transendoscopic laser procedure can result in granulation tissue formation and may take several weeks to resolve [2]. The transnasal hook bistoury-based procedure case had a time from surgery to first race of 74 days, and the transnasal shielded hook bistoury-based procedure case had the shortest time to first race after surgery 69.3 days. Although the number of cases in this study was limited, these results show that a transnasal approach resulted in quicker resolution of epiglottic entrapment than transendoscopic laser and transoral approaches (Table 2). In addition, there was no dorsal displacement of the soft palate (DDSP) in this study, but DDSP is a common sequela to correction of epiglottic entrapment regardless of the technique performed; as many as 20% of horses experience this complication [1, 8]. Therefore, the possibility of DDSP should be conveyed to owners before the surgical correction of epiglottic entrapment.

The postsurgical race rankings improved in all 11 cases after completion of surgery for epiglottic entrapment correction (Table 3). This suggests that surgical repair of epiglottic entrapment can resolve entrapment with reduced race performance. However, cautious generalization is recommended, as the number of cases was small, race records were limited, and many factors influence race performance.

In conclusion, epiglottic entrapment is a rare upper respiratory disorder in athletic Thoroughbreds, but it can be corrected through surgical treatment. The choice of an appropriate surgical technique for successful correction of epiglottic entrapment should be based on the clinician's skill and experience, instrument availability, and the potential for various surgical complications, and caution should be excised with respect to the high risk of complications related to this surgery.

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