Facial Nerve Palsy after Open Reduction of Comminuted Subcondylar Fracture— A Case Report and Literature Review

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Abstract

A 42 years old male suffered from unilateral comminuted condylar fracture visited our department after traffic accident. He was treated with open reduction with internal fixation via retromandibular approach. However, transient facial palsy was found including clinical signs of eyelid poor closure (Lagophthalmos) and mouth angle weakness. In this article, we reviewed 30 related studies to conclude the relation between approaching method and risk of post-operation transient or permanent facial palsy. The result showed that intraoral approach (transient facial palsy risk: 0.72%) has the lowest risk. On the other hand, retromandibular transparotid approach (transient facial palsy risk: 14.4~46.7%) and preauricular approach (permanent facial palsy risk: up to 10%) are more risky during procedure. Also, the most possible factor to cause iatrogenic nerve injury are excess traction, over extension of nerve, and injury of communicating branches between main branches. To avoid the iatrogenic nerve injury, we should choose proper approach method based on the height and location of fracture line for not only getting rid of nerve injury but also protect its integrity.

Key words: Condylar fracture, Facial palsy, Surgical approach.

Introduction

Mandibular condylar fracture is one of the most common (21.1%)[1] fracture site among mandible fracture. Aside from close reduction, there are many surgical approaches for open reduction with internal fixation in treating condylar fracture.

Comminuted fracture of mandibular condyle is relative rare among these cases. Here we would like to report a case who is a 42-year-old male suffered from unilateral comminuted subcondylar fracture after traffic accident. Patient underwent open reduction with internal fixation via retromandibular approach uneventfully. However, unilateral facial weakness has been noted following the surgery, including eyelid incompetence and lower lip drooping. The above symptoms and signs were gone following three months of acupuncture and mecobalamin administration. Recent studies were also reviewed based on the risk of facial nerve injury following the various kinds of approach for open reduction of condylar fracture.

Case presentation

A 41 years old male motorbike rider wearing a 3/4 open face helmet had a traffic collision with a speedy car. Lip laceration and swelling over his right temporomandibular joint area were noted, so he visited an emergency room of local medical unit for treatment. He denied any underlying disease. Wound suturing was done over his lip and he was informed with negative findings of skull plain films. Ten days later, he still felt swelling over his right temporomandibular area with trismus, facial asymmetry, and malocclusion (Fig. 1A, 1B). As a result, he visited local dental office, a comminuted fracture over right subcondylar area was revealed by a panoramic radiograph (Fig. 1C).

Then he was referred to our department for open reduction and internal fixation. Cone beam computer tomography confirmed right subcondylar fracture in three pieces with displacement (Fig. 1D, 1E) which is consistent with the clinical manifestations such as right premature contact occlusion, chin deviation, and trismus (Fig. 1A, 1B). Patient underwent open reduction with internal fixation via retromandibular approach under general anesthesia via nasoendotracheal route in order to check and adjust occlusion during surgery. First, fixation of Erich arch bars application with #24 interdental wires over upper and lower arches was done. The next step was the retromandibular approach.

Retromandibular incision started from the area which is 0.5 cm below the right earlobe. An oblique incision was made through skin and subcutaneous tissue, extending from the mastoid process to a point just below the angle of the mandible (Fig. 2A). The subcutaneous tissue was then undermined, exposing the superficial musculoaponeurotic system (SMAS). An oblique incision was made through the SMAS. The posterior aspect of the parotid gland was identified and dissection continued behind the gland. The gland was lifted off the masseter muscle and retracted anteriorly. The posterior border of the mandible had been reached, an incision was made through the pterygomasseteric sling. A periosteal elevator was used to strip off the masseter muscle from the mandibular ramus. Further dissection superiorly along the posterior border exposed the condylar process and unveiled the fracture line over subcondylar area as well. Debridement between the fractured segments were performed and reduction the segments to proper position were achieved smoothly by using a wire loop around a miniscrew (Kirschner's method) (Fig. 2B). Internal fixation was done with one 6-hole miniplate (AO mandible matrix 1 mm), one 3-hole miniplate (AO mandible matrix 1 mm), one 3-hole miniplate (AO midface 0.5 mm), and twelve 8 mm miniscrews were

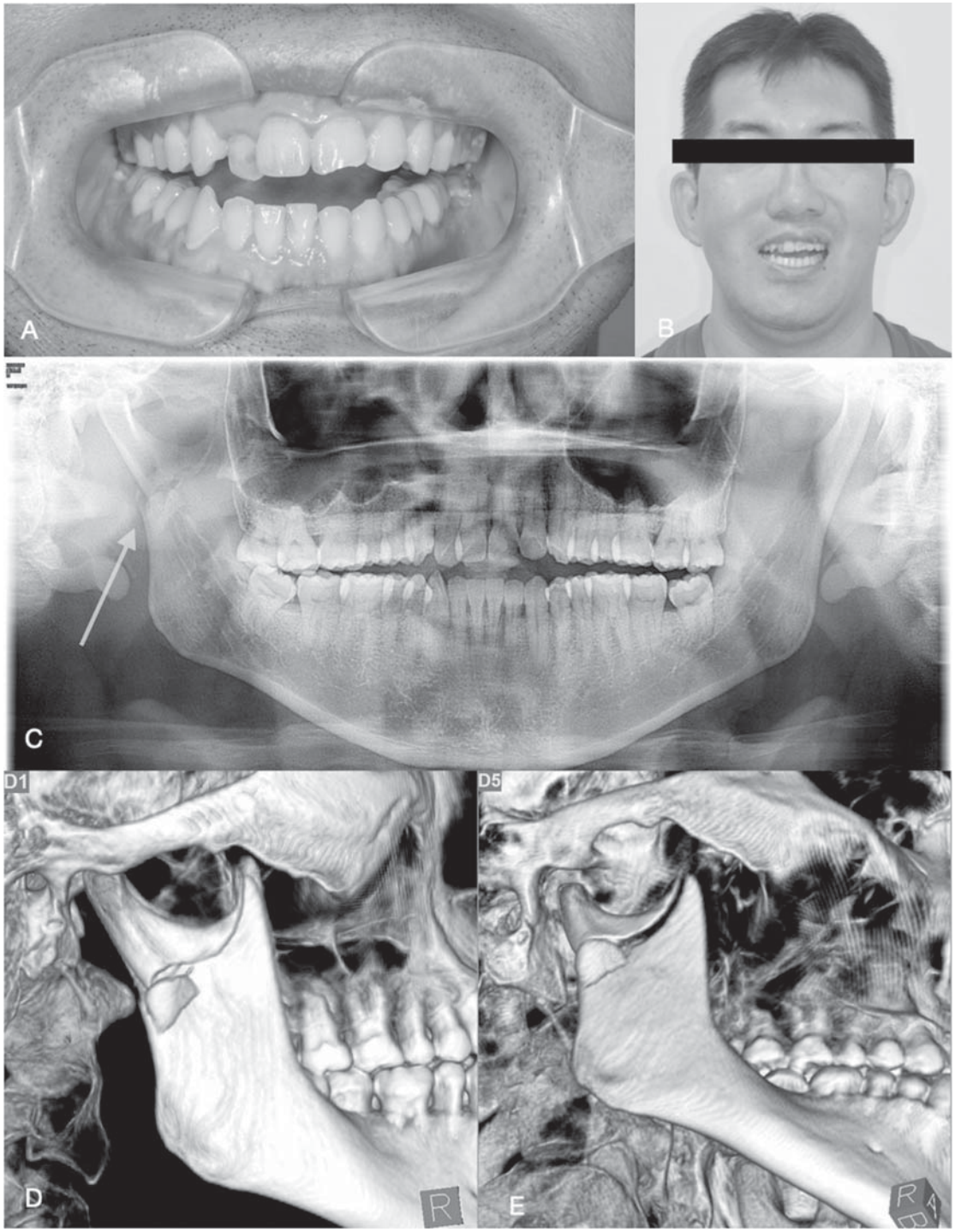

Fig. 1. A: Right premature contact induced malocclusion of anterior and left open bite.
B: Chin deviation to right due to right ramus vertical height shortening.
C: Pre-operative panoramic film: right comminuted subcondylar fracture (arrow), negative of other fracture line in mandible and maxilla.
D & E: Preoperative cone beam computer tomography: revealed relative location between segments of the comminuted fracture.

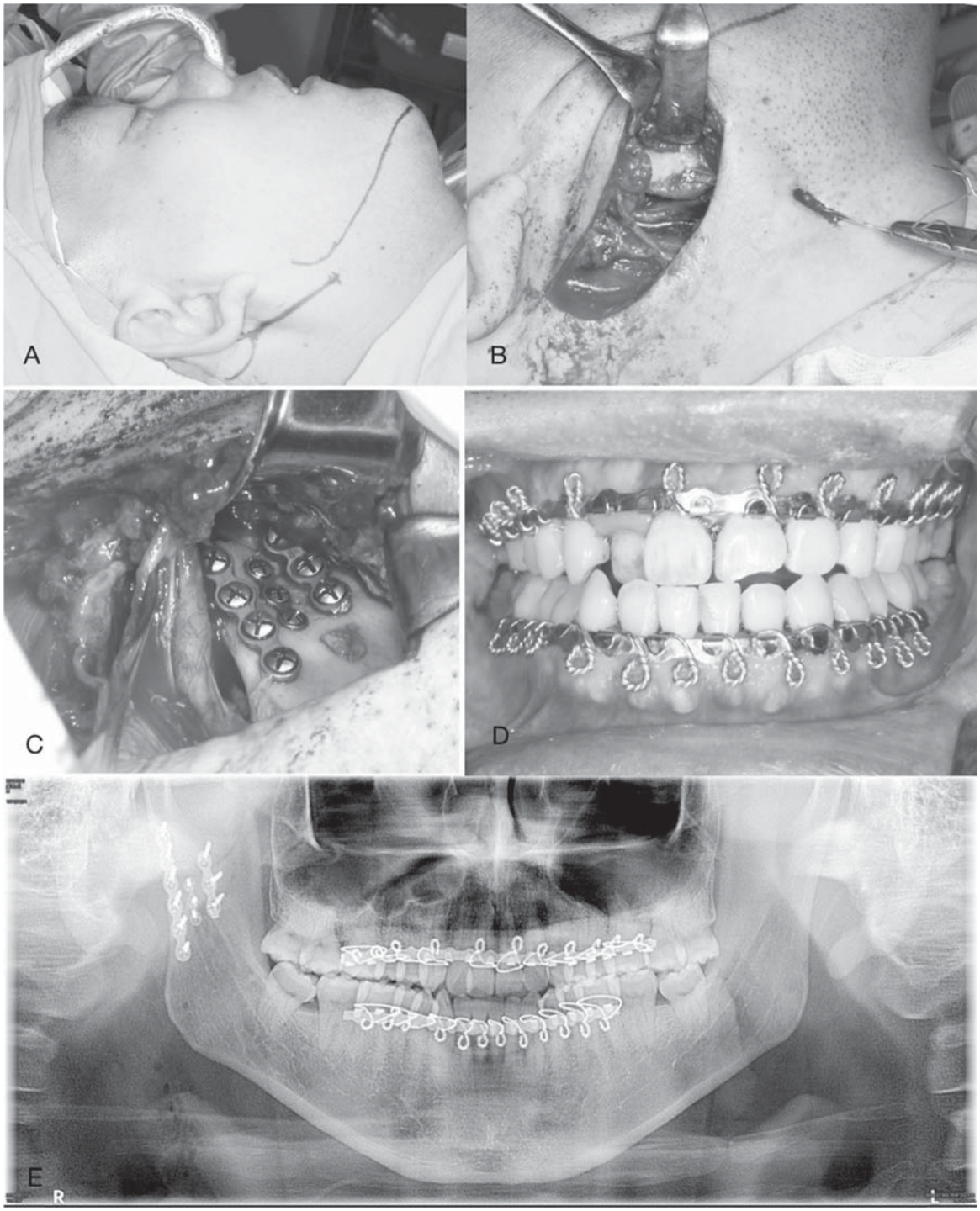

Fig. 2. A: Skin incision line design for retromandibular approach.
B: Reduction of distal segment with Kirschner's technique.
C: Internal fixation with 3 mini-plates(one 6-hole, two 3-hole), totally 12 mini-screws.
D: Post-operative occlusion with maximum intercuspal position.
E: Panoramic film taken on post-operation day 1, proper reduction and rehabilitation of ramus height were noted.

placed after checking occlusion with following intermaxillary fixation (Fig. 2C, 2D). Wound closure was done following copious N/S irrigation. Intraoral wound was primarily closed, layer by layer with 4-0 Vicryl and 5-0 Nylon. Finally, we replaced the intermaxillary fixation with elastic guiding band. Antibiotics of Cefazolin as 1 g per 8 hours and Ketolorac 30 mg per 6 hours were administered intravenously in bolus for infection and pain control. Mild right eyelid incompetence, persistent numbness over right post auricular area, and right lower lip paresthesia were noted, therefore, mecobalamin 500 mg 3 times a day for three months has been prescribed. Patient was discharged on the second day after the operation.

Patient was followed-up at the time points of 1st week, 1st month, and 4th month following surgery. Panoramic film showed favorable reduction of comminuted segments and rehabilitation of right mandibular ramus height (Fig. 2E). Acupuncture was performed to improve Lagophthalmos. At the post-operative 3 month follow-up, facial expressions has been totally recovered, the right eyelid poor closure (Lagophthalmos) has completely vanished. However, numbness over the distribution area of right post auricular area was still persisting. No gustatory sweating (Frey's syndrome) was noted. On the other hand, rehabilitation of occlusion has been so successful to enable him to have normal diet with acceptable mouth opening dimension (44 mm) and stable maximum intercuspal position occlusion. The post-operative progress in three months is satisfactory, compared with the pre-operative malocclusion with open bite.

Discussion

There are various kinds of surgical approaches for condylar fracture, such as intraoral approach, pre-auricular approach, retromandibular approach (including trans-parotid and retro-parotid), and submandibular (Risdon's) approach. Here we would like to describe the

Table 1. Conclusion of percentages between transient and permanent facial nerve palsy in different types of approach.

	Subtypes	Transient facial nerve palsy risk (recovered in 6 month)	Permanent facial nerve palsy risk
Intraoral approach	-	0.72%[6]	0%[6]
Pre-auricular approach	-	10%[6]	0.3%[6]
Retromandibular approach	retroparotid	-	-
	transparotid	14.4%[6], 20.4%[14], 46.7%[19, 20]	1.4%[6]
	transmasseteric (anteroparotid)	2.7%[6]	1%[6]
Risdon's approach	-	15.3%[6], 5.8~48%[7], 10.5%[19, 20]	2.2%[6]
Endoscope-assisted approach	transoral (intraoral)	3.4%[6]	0% (0 of 15 cases)[8], 0%[6]
	submandibular (extraoral)	4.2%[6], 6.7%[8]	0% (0 of 15 cases)[8]

above surgical approaches regarding the risk of facial nerve injury by reviewing literatures published in recent decades.

Approaches for open reduction and internal fixation include-

(1) Intraoral approach

Intraoral approach to condylar area is very similar to the incision for intraoral vertical ramus osteotomy. It starts from the related vestibular area of lower first molar, about 5 mm below the mucogingival junction, extending up to external oblique ridge and ascending ramus, depending on the height of the surgical site.

For achieving adequate surgical access and device placement, the temporalis muscle attached to the mandibular ramus and the buccinator located at the mandibular body should be completely dissected and reflected[2]. Compared with other extra-oral approaches, intra-oral approach has an advantage in minimal injury of facial nerve branches as well as no facial scar formation. For the limited surgical field of subcondylar or condylar neck area, it needs endoscopic-assisted system to achieve internal fixation. It is technique sensitive and requires a longer learning curve for fixation.

(2) Preauricular approach

Preauricular approach is an appropriate way to accomplish open reduction and internal fixation over condylar head and neck area. It starts from the inferior border of tragus toward to external auditory canal and extends along the skin crease for about 3 to 4 cm long, then goes deeper through the SMAS to the temporalis fascia. While dissecting along the external auditory canal, identification of zygomatic arch is so essential for this approach for that it secures the zygomatic branch of facial nerve on the flap by stripping off the periosteum from zygomatic arch. Temporomandibular joint capsule can be exposed and this exposure is preferred in achieving internal fixation of intracapsular fracture and high condylar neck fracture.

(3) Retromandibular approach

Retromandibular approach offers an advantage of wider surgical exposure and a favorable access to the mandibular condyle area, including the area of condylar neck and subcondyle. The incision starts from the area 0.5 cm below the earlobe and extends downward as 3-3.5 cm in length. Going down through the platysma muscle, the SMAS layer will be exposed. At this level, the facial nerve and its main branch will not be revealed because they exist between superficial lobe and deep lobe of parotid gland. After going through the SMAS layer, parotid gland would be encountered and it would cause injury to facial nerve and its main branches. The path of dissection should be parallel to the direction of marginal mandibular branch. Identification of retromandibular vein, marginal mandibular branch and cervical branch will be advised. Finally the pterygomandibular sling and periosteum are incised and then the condylar neck and subcondylar area could be approached.

Furthermore, there are alternate ways to performed retromandibular approach, which are transmasseteric antero-parotid and retroparotid methods. Transmasseteric antero-parotid approach first goes superficial to the SMAS layer and then goes down through the SMAS at the region anterior to the parotid gland. The dissection then goes through the masseter muscle and down to the bone of the mandible. For retro-parotid approach, we have to identify the posterior border of parotid gland first and then dissect and pull the parotid gland anteriorly so as to expose the pterygomandibular sling. Following

cutting through the pterygomandibular sling, the mandible is approached.

(4) Risdon's (submandibular) approach

Risdon's approach is one of the most useful surgical approach to the mandibular ramus and posterior body region. The marginal mandibular branch of facial nerve is one of the most cautious vital organ during this dissection. This branch arises from the cervicofacial branch of facial nerve which innervated the motor fibers to the facial muscles in the lower lip and chin. According to Dingman and Grabb's epic study[3] of facial, the marginal mandibular branch runs below mandibular border 1 cm averagely. The incision line should be better located about 1.5~2 cm inferior to the mandibular border. The skin incision extends 4-5 cm in length. Following the skin is incised, the platysma muscle is cut and then the superficial layer of the deep cervical fascia is exposed. The marginal mandibular branch of the facial nerve is within this layer. Cautions should be paid here to avoid injury to the facial nerve. No need to identify the nerve here actually. The key point is to identify facial artery and vein with blunt dissection, based on the research of Ziarah and Atkinson[4] in which that the marginal mandibular branch passes between the facial artery and facial vein. Therefore surgeons ligate the facial vessels and then cut through the superficial layer of deep cervical fascia. The pterygomandibular sling was then found and incised, the mandibular angle, body and ramus area will be exposed finally with clear periosteal reflection.

(5) Endoscopy-assisted approach

Endoscopy-assisted approach and reduction has huge advantage in limited incision wound and the risk of iatrogenic facial nerve injury during approaching. There are two usual ways to performed endoscopy-assisted approach: trans-oral and submandibular combined intra-oral approach.

To performed a trans-oral approach, it starts from intra-oral incision which is similar to sagittal split osteotomies in orthognathic surgery. The periosteum on the ascending mandibular ramus is elevated down to the mandibular angle and the inferiorly inserting fibers of the temporalis muscle are stripped off the muscular process to create the optical cavity[4]. Because the optical cavity is not a closed space as in intra-abdominal or intrathoracic procedures, mechanical traction must be used to maintain it. This is conveniently achieved by inserting at this point the transbuccal sleeve and its cheek retractor. A point immediately over the palpated location of the posterior aspect of the fracture line is selected and marked, and a small stab incision just through dermis is made 4-5 mm long in the direction of the relaxed skin tension lines. Using a blunt curved hemostat, this incision is deepened by gently spreading the tips of the hemostat parallel to the predicted direction of the facial nerve branches. This dissection is carried through the parotid gland and masseter muscle in order to enter the wound directly over the posterior aspect of the fracture line. The sleeved trocar is inserted and the cheek retractor is mounted on the trocar sleeve to allow the maintenance of the optical cavity by gentle traction[5]. Also, endoscopy-assisted trans-oral approach can be done totally intraorally. After reaching the ramus as method mentioned above, the endoscope was inserted subperiosteally without incision of the masseter muscle and advanced cranially towards the fracture until the fracture gap became visible in the endoscope. Angulated drill and screw driver can achieve fixation after proper reduction[4].

Submandibular combined intraoral approach is more suitable rather than transoral approach in the cases with more clear view of posterior border of ramus and severely dislocated fractures such as fractures with medial override or comminution[4]. Still, intraoral approach which is similar to sagittal split osteotomy should be done first, then use a hemostat was introduced through the oral incision to the inferior border of ramus, and soft tissue over the lower border of the ramus was bluntly dissected to reach the skin. A 4 mm stab incision was then made against the prominence of the hemostat. An angulated endoscope was introduced through the submandibular stab incision and set to see the operating field. Subperiosteal dissection proceeded proximally beyond fracture site under the endoscopic view. Also, fragment reduction can be done with Kirschner's technique that use a wire loop and screw on the distal segment to reduce segments. Fixation with mini-plates is able to be done with angulated drill and screwdriver through intraoral incision approach.

When it comes to surgical approach for treating mandibular condylar fractures, there are some important directions that must be considered, such as postoperative complications, for instances, the risk of injury over facial nerve and its branch, salivary fistula, and mouth opening. Among these complications, facial nerve injury is the most severe complication. Therefore, we reviewed studies in recent years about risk of facial palsy in different ways of approach.

Facial nerve is the most important anatomic structure that should be preserved and protected during surgical exposure of mandibular condylar and subcondylar area. A systemic review of facial nerve injury in various surgical approaches has been published by Al-Moraissi et al. In this study, a total 96 studies was reviewed and enrolling a total of 3873 patients. The surgical approaches have been classified into several groups: intraoral approach (divided into with trocar and with endoscope-assisted fixation), low-submandibular (Risdon's) approach, peri-angular approach, retromandibular approach (further divided into transmassteric antero-parotid, trans-parotid, and retro-parotid method), pre-auricular approach and post-auricular approach. The overall transient facial nerve injury was as below(from high to low): low-submandibular approach (15.3%), retromandibular approach with trans-parotid method (14.4%), preauricular approach (10%), intraoral with endoscopy-assisted (4.2%), retromandibular approach with transmassteric antero-parotid method (3.4%), and intraoral with transbuccal trocar method (2.7%)[6].

Obviously, the low-submandibular (Risdon's) approach group has the highest risk to cause transient facial nerve injury among all the groups. In the studies of Manisali et al. in 2003 and Widmark et al. in 1969, the chance of facial nerve injury in submandibular approach was ranged from 5.8% to 48%[7, 8]. The main reason to explain this result is that the long distance between the incision and the fracture line (condylar neck), substantial traction of the soft tissues is usually required to perform open reduction and apply rigid fixation. Therefore, nerve injuries secondary to traction may occur[6].

There is also a high incidence (14.4%) of facial nerve injury in retromandibular approach with trans-parotid method. To analysis the reason, we should consider the differences between the three main subgroups of retromandibular approach. First, the incision, dissection, and retraction within the parotid gland. After the facial nerve main trunk exits

from the stylomastoid foramen, it runs about 2 cm deep from skin, 1.5~2 cm below the extra-auditory meatus, extend about 1.3 cm long before entering the parotid gland, then divided in two divisions, finally formed the five main branches then exit the parotid gland. Obviously, the trans-parotid method can cause the highest risk of nerve injury during dissection and retraction. In retro-parotid method, it may also cause damage of the facial nerve trunk, which is also the main reason why pre-auricular approach has a high incidence (10%) of facial nerve injury Second, the difficulty of identifying is different from nerve between the masseter muscle and parotid gland tissue. It is more easily to identify the nerve branch on the muscle, which means it is more easily to avoid iatrogenic nerve injury[6]. Third, at the level of condylar area, it is the so called "silent zone of facial nerve". There are a plenty of facial nerve fibers intermingle and anastomose with each other. Should one of these branches malfunction after surgery, then there is a very high chance that other branches may carry the functional duty instead[6]. To conclude these three main reasons, the retromandibular approach with trans-parotid method has the highest risk of the nerve injury, instead, transmasseter antero-parotid approach is the safest way. These results are similar to most previous studies[9-20].

Intraoral approach is the safest way (4.2%~2.7%) among all kinds of approaches. Either approach with transbuccal tracer or assisted with endoscope, there is still remaining risk of minor nerve branch injury, however, although intraoral approach is relative safe compared with other method, its limited surgical view has limited its use, so that angulated drill and screw driver may be needed and which required more experiences and is technique sensitive.

Fortunately, all kinds of approaches have low risk of permanent facial nerve injury. The low submandibular approach is still at the highest risk, but it is just about 2.2% overall, which is obvious lower than the risk of permanent facial nerve injury. Thus, as the main branch or trunk is avoided from direct or severe indirect injury (i.e. traction), these surgical approach methods are safe to performed[6].

In study of Handschel et al[14], 111 condylar fractures were collected, and depending on the fracture site (i.e. intracapsular, superior condylar neck, inferior condylar neck) and fracture pattern (i.e. dislocation, displacement, either or neither), different ways of approach including intraoral without trocar and endoscope, pre-auricular, submandibular, and retromandibular with trans-parotid method. The result showed the submandibular (4 of 38, approximately 10.5%) and the retromandibular approach (6 of 28, approximately 20.4%) showed worse results with respect to temporary palsy of facial nerve. However, in consider of permanent palsy of the facial nerve (examined about 1 year after operation), submandibular group still had the worst result (4 of 38, about 10.5%). This result was pretty similar to previous mentioned study from Al-Moraissi et al.[6]

Comparison in facial nerve palsy between endoscope-assisted method and other surgical approaches has been another popular issue in recent studies. Nogami et al. compared endoscope-assisted method and retromandibular approach with nerve detector assistant[21]. Both group has 15 patients each, and the result showed that in temporary facial paresthesia (within in 1 month after operation), the retromandibular group has a significant high risk (7 of 15, 46.7%) related to endoscope-assistant group (0 of 15).

On the other hand, as previously mentioned in this article, there are two kinds of endoscopy-assisted approach: submandibular (extraoral) and transoral (intraoral) method[23, 24]. According to study of Hwang et al[8], 15 patients in each groups, results showed there was only 1 patient had temporary facial paresthesia in submandibular method and none of patient in transoral method suffered from this complication. After long-term follow-up (at least 6 months), none of all patient had facial paresthesia. Thus, this result revealed that no matter submandibular or transoral method of endoscopy-assisted approach, the risk of facial nerve injury is relatively low and both methods are safe to perform[8].

Frey's syndrome is one of the most common complications after surgery with approaches to parotid or condylar area. It is caused by sectioned paraparasympathetic secretomotor fibers accidently connected to sympathetic cholinergic fibers which innervates cutaneous facial sweat glands[25]. As a result, sweating or flushing around parotid area during meals might occur. The chance of Frey's syndrome may be up to 50% (15% with severe symptoms). To prevent this condition, SMAS layer as a flap or superficial temporal artery fascia flap can be used as a barrier to block inappropriate nerve connection. Once Frey's syndrome did happen, botulinum toxin (BTX) injection can be considered. It is a polypeptide produced by Clostridium botulinum. The mechanism is that it can decrease the release of acetylcholine and which is important to connect nerve and striated muscles. BTX has been a gold standard treatment to Frey's syndrome because of its effectiveness and minimal complications[25-30].

To compared with our case, we did retromandibular approach and although its transient post-operative facial nerve palsy rate was nearly less than 15%, it still had been happened. Iatrogenic temporary facial nerve palsy in our case may result from excess traction force during operation. Sufficient surgical vision exposure must be done to prevent nerve injury due to traction. Fortunately, the complication including eyelid incompetence and mouth angle weakness were much more improved.

Conclusion

In conclusion, although the temporary facial nerve palsy may be at high risk especially when retromandibualr trans-parotid approach or preauricular approach is used, results of permanent (more than 6 months) facial palsy are relatively low if no direct structural injury to main branches occurred. To avoid this complication, the choice of the surgical approach (skin incision route) should be determined by the height and position of the fracture. For instance, pre-auricular in condylar head fracture, intraoral approach in simple and minimal displaced subcondylar fracture, retromandibular approach in complicated condylar fracture. Because we need to avoid excess traction or over extension of the facial nerve, and to protect nerve integrity.

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下顎骨髁下粉碎性骨折經開放性復位術術後顏面神經麻痺一病例報告及文獻回顧

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摘 要

一位42歲男性患者，因車禍導致右側下顎骨髁下粉碎性骨折，採用經後下顎骨手術探查之開放性復位固定術，重建其咬合功能。然而術後產生暫時性顏面神經麻痺，其中包括右眼瞼閉合不全、右口角無力等臨床症狀。藉由此病例本篇回顧了30篇文獻，探討因下顎骨髁處骨折經各式手術探查方式術後之暫時性或永久性顏面神經麻痺之風險及其原因。結論是經口內手術探查爲最安全的方式(暫時性顏面神經麻痺風險約0.72%)，然而較具高風險的則是經腮腺之後下顎骨手術探查(暫時性顏面神經麻痺風險約14.4~46.7%)及耳前手術探查(永久性顏面神經麻痺風險可達10%)。其可能原因包括術中過度拉扯或延伸神經主幹及其分支，或是在探查過程中破壞其神經交通支。建議由骨折高度及部位來決定適合的手術探查方式，以避免上述醫源性神經損傷及保留其完整性。

關鍵詞：下顎骨髁骨折，手術探查，顏面神經麻痺。

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