Endoscopically Assisted Removal of Tumors in the Frontal Region

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Background: Advancements in endoscopic surgery, due in part to patient demands and in part to provision of superior medical care by surgeons, have significantly contributed to improvements in patients' quality of life. An endoscopic operation is minimally invasive, associated with faster recovery, and produces less postoperative morbidity. It is a well-accepted procedure in the field of plastic surgery. By applying the principle of endoscopic surgery used in facelift operations, we performed tumor excision in the forehead region.

Methods: Two 1.5-cm slit incisions were made in the anterior hairline. One incision was to allow access for the 4.0-mm, 30˚ endoscope, and the other was for surgical instrumentation. These incisions, determined by the plane of dissection, were more superficial and below the subgaleal layer for soft tissue tumors and deeper into the subperiosteal layer for bone tumors. With good illumination and magnified monitor viewing, the tumors could clearly be visualized and were completely excised.

Results: Seven patients with either dermoid cysts (3), osteomas (2), or lipomas (2) underwent endoscopically assisted procedures. In all cases, tumors were successfully excised with no acute or chronic complications. The average postoperative follow-up period was 7 months. No incidence of tumor recurrence was reported. All patients were satisfied with the resultant forehead contour and surgical scars.

Conclusions: The main advantage of this procedure is the fact that it is minimally invasive, thus reducing the incidence of injury to the neurovascular structures of the forehead as well as minimization of scar visibility. In conclusion, an endoscope-assisted approach is a good alternative method for managing benign soft-tissue and bone tumors in the forehead and brow region.
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Key words: **endoscope, forehead tumor.**

With rapid advancements in medical care, both surgeons and patients seek better outcomes. Surgeons search for better surgical techniques in an attempt to decrease operative morbidity and improve

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the quality of results. Patients, on the other hand, desire a faster recovery as well as better functional and cosmetic outcomes. Recently, great interest in minimal-incision surgery has led to the development of endoscopic techniques in the field of plastic and reconstructive surgery. In our department, endoscopic surgery and its technique have been developed to assist in the repair of facial fractures, including orbital, subcondylar and zygomatic fractures, over the past few years.[1-4]

For surgery in the forehead area, the endoscopic technique has been applied to aesthetic surgery such as forehead lifts,[5-7] and reconstructive surgery such as forehead re-contouring[8] or frontal sinus fracture repairs.[9-11] In all of these procedures, postoperative morbidity has been reported to be less than that of the bicoronal approach. The main advantages of endoscopic surgery are small incisions and the absence of visible scarring on the face. To further exploit its benefits, we attempted to use the endoscope to assist in the removal of benign bony and soft-tissue tumors in the forehead region. This report presents our surgical technique and early clinical experience with endoscopically assisted forehead tumor extraction.

METHODS

A consecutive series of 7 patients (4 males and 3 females including 1 child) with a forehead protruding mass was selected to undergo excision of their forehead lesions via an endoscopic approach (Table 1). These patients all presented with a slow-growing, painless mass in the frontal or supraorbital region. Preoperative tissue diagnoses were not obtained, but careful history-taking and a physical examination often revealed characteristic features of a benign growth or disease progress. Five patients had preoperative computed tomographic (CT) exams for further confirmation and evaluation of the tumor extension. All patients were otherwise healthy without other facial abnormalities. These patients chose the endoscopic approach after discussion with the surgeon, and desired to have the tumour removed without obvious facial scarring.

Surgical technique

Under general anaesthesia, a patient was made to lie supine on the operating table with the head in the neural position. The entire unshaven scalp and face were prepped and draped; methylene blue was then used to mark the protruding mass for excision and the scalp incisions. Two 1.5-cm slit incisions within the hair were made 2.5 cm apart directly above the mass in the anterior hairline (Fig. 1). The exact position of these incisions was dependent on

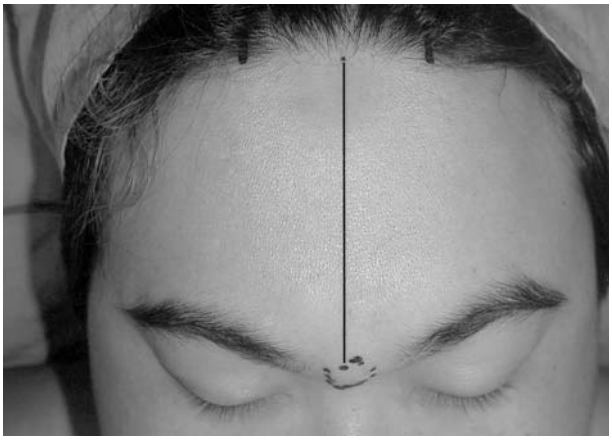

Fig. 1 Preoperative marking with 2 slit incisions made behind the anterior hairline. The right one is used for insertion of surgical instruments, and the other for endoscope entrance in a right-handed surgeon.

Table 1. Patients Characteristics and Results

Age (yr)	Gender	Tumor location	Tumor size (cm)	Pathology	Morbidity	Follow-up (month)
2	F	Left lateral brow	2×1.5	Dermoid cyst	-	2
19	M	Glabella	3.5×2	Dermoid cyst	-	3
25	M	Glabella	2×1.5	Dermoid cyst	-	6
18	M	Middle forehead	1.5×1	Osteoma	-	6
27	F	Left medial brow	2×1.5	Osteoma	-	18
47	M	Right forehead	2.5×1.5	Lipoma	-	8
40	F	Left forehead	2×2	Lipoma	-	6

the area that was to be endoscopically approached. One incision was to allow endoscope entrance, while the other was for surgical instrumentation access. The forehead was then infiltrated with normal saline containing 1:200,000 epinephrine for both hemostasis and hydrodissection. Infiltration was limited only to areas that were to be undermined. The depth of the incisions was dependent on the plane of access required (subgaleal access for soft-tissue tumors and subperiosteal access for bone tumors) and on the extent of resection required. A freer elevator was first inserted to elevate the scalp from the underlying bone and thus to create an optical cavity. A 4-mm, 30˚ endoscope (Karl Stors, Germany) was then introduced through the other incision to assist with the dissection.

For tumors located around the glabellar and medial brow region, endoscopic visualization and dissection were used to prevent injury to the supraorbital and trochlear neurovascular bundles. According to Lorenc et al.'s study, the average distance from the exit of the supraorbital nerve and supratrochlear nerve to the forehead midline is 2.7 and 1.7 cm, respectively.[12] The supraorbital nerve courses below the frontalis muscle from its notch to 3.5 cm above the rim where it penetrates the muscle. The supratrochlear nerve passes through the corrugator muscle and innervates the medial forehead. During dissection and muscle splitting to explore a soft-tissue tumor overlying muscular layer, the peripheral nerves and vessels were carefully identified and protected with an endoscopic nerve hook.

If the mass was located in the lateral brow region, the periosteal fiber along the superior temporal line was released to increase the optical space laterally. The dissection plane was kept superficial to the deep temporal fascia so as not to injure the frontal branch of the facial nerve. When the location of the soft tissue mass was ascertained, the overlying galeal or subcutaneous layers were split to expose the undersurface of the tumor. Gentle dissection was then carried out to free the tumor from the surrounding tissue bilaterally, with maximal preservation of the cystic wall of the mass under endoscopic visualization. External pressure was applied to the overlying skin superficial to the tumor to facilitate dissection on the superior surface of the mass. Once the tumor had been completely excised, it was extracted from the scalp incision with an endoscope grasper (Fig. 2).

If the lesion was an osteoma, the mass was readily exposed after subperiosteal undermining. In contrast to the removal of a soft-tissue tumor, a traction suture was made just superficial to the osteoma, for lifting the forehead flap upwards, thus facilitating a larger operating space. A small reciprocating saw with a long shaft or a bone chisel was inserted to excise the tumor under direct endoscopic vision (Fig. 3). After excision, the irregular surface of the surrounding cranial surface was smoothed with a high-speed, extended-length burr.

Following adequate tumor resection, the cavity

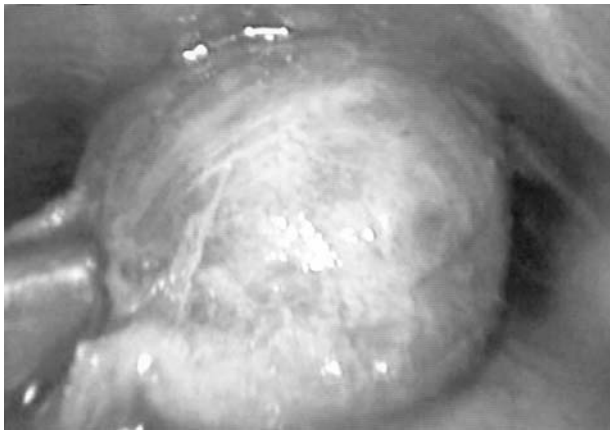

Fig. 2 Endoscopic view of a dermoid cyst freed from the surrounding tissue and held with an endoscopic grasper.

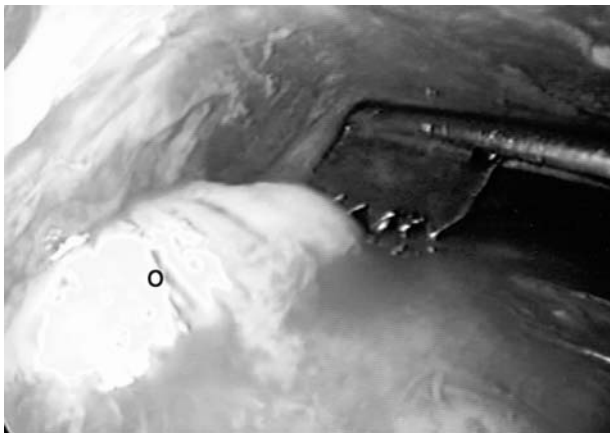

Fig. 3 Intraoperative view of a forehead osteoma (O) which was excised using a small reciprocating saw.

was washed with normal saline. The scalp wounds were then closed with interrupted sutures with no drainage. Compression dressing on the forehead was not used.

RESULTS

In all 7 patients, the mass was successfully excised without conversion to the conventional open method via either a direct skin incision or by utilizing the bicoronal approach. Soft-tissue tumors, with intact capsular walls, were completely removed without rupture. For all patients, the postoperative course was uneventful, and pathological examination confirmed that all tumors were benign.

The follow-up period for these patients ranged from 2 to 18 months with an average of 7 months. Neither permanent scalp numbness, wound infection, hematoma, apparent incisional alopecia, nor temporal hollowing was observed in any of these patients. To date, there have been no signs of tumor recurrence either. All patients were satisfied with the forehead contour and hidden surgical scars (Figs. 4-5).

Fig. 4 (A) Preoperative view of a tumor (arrow) in the glabellar area of a 25-year-old man. (B) Tumor mass proven to be a dermoid cyst which was excised completely without rupture of the cyst wall. (C) Postoperative view 3 months after the operation.

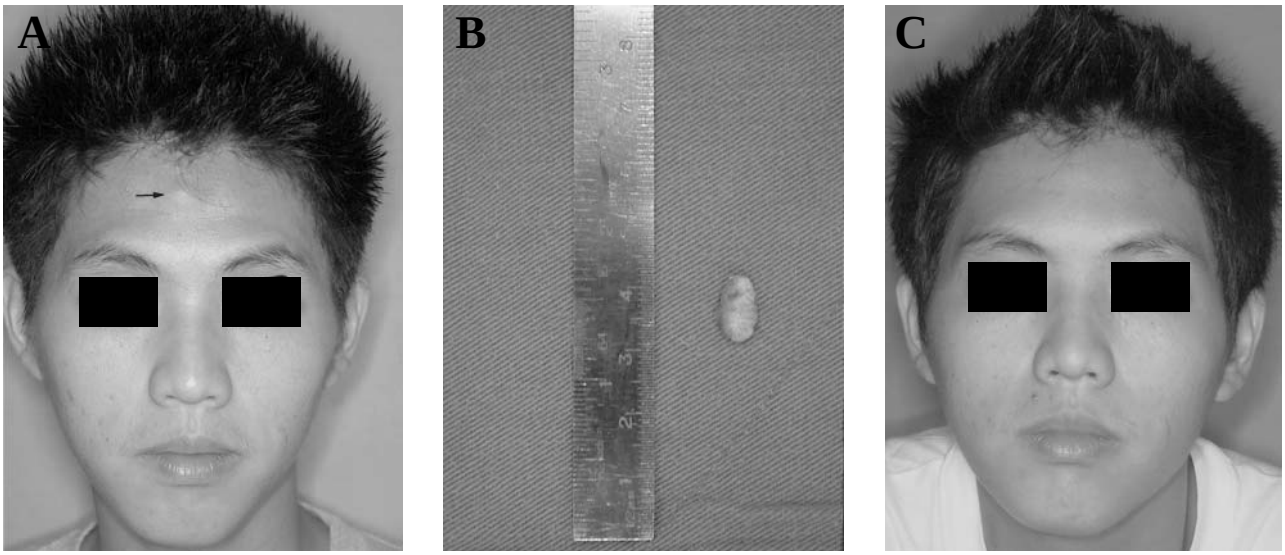

Fig. 5 (A) A Preoperative appearance of a protruding mass (arrow) in the mid-forehead. (B) A 1.5×1-cm osteoma completely excised via an endoscopic procedure. (C) Postoperative appearance with a smooth contour of the forehead.

DISCUSSION

A tumor in the skull may be benign or malignant and may originate from different cells. Fortunately, malignant bone and soft-tissue tumors account for fewer than 1% of cancers. The most-common calvarial benign tumors are osteomas and hemangiomas, while the most-common malignant lesions are osteogenic sarcomas. In pediatric groups, dermoid and epidermoid cysts are the most-common benign lesions. The detailed classification of skull tumors is beyond the scope of this discussion.

A preoperative physical examination including determination of the evolution, texture, location, mobility, and appearance of the lesion may be useful in differentiating benign from malignant tumors. Neurological symptoms and signs are related to the degree of intracranial extension. A careful preoperative radiographic examination of the lesion including a plain skull roentgenogram and computed tomographic scan is helpful in establishing a diagnosis. A general consensus was obtained that lytic lesions with smooth edges, the presence of circumferential sclerosis, and expansion of the diploic space usually favor benign lesions on the radiographic examination.[13] Therefore, the endoscopic techniques developed can only be applied to perform excisional or incisional biopsies of radiographically presumed noninvasive and benign tumors encountered in the forehead and supraorbital brow region.[14] This technique is not indicated for those tumors suspected of having malignant behavior or with intracranial invasion.

Dermoid lesions are congenital hamartomas and are often present in children as slow-growing masses. They typically arise from cleft closure lines, including derivatives of 2 separate germ layers. These tumors may contain sebaceous glands, hair follicles, cartilage, or bone. Most of the periorbital dermoid cysts are found above the lateral 1/3 of the eyebrow, but they could also present as masses around the naso-orbital and temporal areas. An osteoma is a benign tumor arising from the membranous bones of the skull and is histologically composed of dense, mature lamellar bone. It is classified into 3 types: conventional classic osteomas, periosteal osteomas, and medullary osteomas. Conventional classic osteomas are the most-common kind, with the majority occurring in the craniomaxillofacial region.[15]

Removal of these benign tumors is only indicated if they cause clinical symptoms; however, patients often present with a request for their removal for cosmetic reasons. Conventionally, these tumors are removed through direct skin incisions over the mass itself. The incisions of this technique are wider to allow complete removal of the tumor, and bilateral extensions are often necessary to allow burring of the cranial surface after excision of an osteoma. The forehead is a conspicuous part of the face, and any incisions in this area inevitably result in visible scars even if the incision is parallel to the facial expression lines. Consequently, remote coronal incisions have been used as an alternative to minimize scar visibility. Small coronal incisions, however, allow limited access to the lesions, often making the procedure technically difficult. The extended bicoronal approach, on the other hand, provides excellent exposure, as well as well-hidden scars. Nevertheless, it has many associated postoperative morbidities, such as a long scalp scar, alopecia, scalp paresthesia, chronic scalp pruritus, increased intraoperative blood loss, and also a risk of temporal hollowing secondary to extensive surgical dissection.[16,17] These are relatively major complications for the removal of a small, benign forehead mass. Another alternative approach to dermoid cysts which are situated in the lateral 1/3 of the brow is via a superior eyelid incision. This approach has been reported to produce excellent results with low complication rates.[18] Kersten, however, reported later problems associated with early scar retraction, increased postoperative swelling, and ecchymoses.[19]

With the endoscopically assisted method, only 2 small incision in the hairline are required to achieve similar exposure and access as that of a bicoronal incision. This method also provides direct and magnified visualization of the mass, facilitating minimal tissue manipulation and avoidance of neurovascular injury. An excellent esthetic outcome can also be achieved, with no forehead scarring as a sequela. Ramirez reported a 95% satisfaction rate using the endoscopic approach in patients who need forehead-lifting surgery.[20] Our colleagues, Lin et al. have also reported that patients' outlooks about their scars, as well as their overall satisfaction rate, were better and higher in the endoscopic group in comparison to those who had more-traditional open procedures for

free latissimus dorsi muscle flap harvests.[21] In our present series, all patients themselves as well as their families have been more than satisfied with these "scar-less" operations.

Lin and coworkers have endeavored to decrease the number of scars in endoscopic procedures by using only one 2.5-cm horizontal incision for both the endoscope and surgical instruments.[22] Our preference, however, for this particular procedure, would be to utilize 2 small longitudinal incisions instead of 1 longer transverse incision. This can avoid injuring small nerve fibers of the supraorbital and supratrochlear nerve which run vertically through the forehead to the scalp. Two separate ports can also better facilitate the creation of an adequately large optical space, to allow complete and clear visualization of the tumors[14,15] as well as maneuverability during the excisional procedure.

The layer of endoscopic dissection to reach the mass can be either subgaleal or subperiosteal. This is often dependent on surgeon preference as well as tumor location. Papay et al.[14] and Onishi et al.[23] both advocated subperiosteal dissection, even for soft-tissue masses; the soft-tissue capsules are exposed by splitting the periosteum. From our experience with endoscopic forehead lifting, we found the optical cavity becomes tighter if subperiosteal dissection is used because the periosteum is less stretchable than the galeal layer. Even if the dissection begins from the subperiosteal layer and then changes to the subgaleal layer in the mid-forehead to reach a soft-tissue tumor in the glabellar area, this 2-plane dissection further hinders endoscopic visualization. Therefore, we concur with Lin et al.'s opinion,[22] who suggested that subgaleal dissection offers a more-direct approach to soft-tissue tumors, thus this approach is easier and faster than the subperiosteal approach. In contrast, bone tumors (osteomas) are more easily visualized via subperiosteal dissection.

Drawbacks of the endoscope-assisted approach include the need to invest in endoscopic equipment, the fact that it is technically demanding, as well as the progression period through the learning curve, where initially, operative times are increased. Onishi and colleagues reported that the average time for an endoscopic operation was 14 min for osteomas and 23 min for lipomas.[23] However, the average operating time from the first incision to closure was 21 min for direct excision of a dermoid cyst via a superior eyelid incision in Ruszkowskin et al.'s study[18]. Although, the endoscopic approach may take longer than the conventional open method, an increase in experience is often inversely related to the length of the operating time, as it is with all surgical techniques. The added advantages of endoscopic surgery, such as decreased surgical morbidity, elimination of longer incisions, and minimization of scarring, justify its superiority in providing better outcomes when removing forehead tumors.

In summary, endoscopic surgery is becoming more frequently used in the field of plastic and reconstructive surgery, and has already proven its popularity and utility in accessing the forehead and brow area for cosmetic procedures such as forehead-lifting surgery. In the utilization of endoscopic techniques for excision of forehead tumors, the size and location of surgical scars produce more cosmetically acceptable outcomes compared to those created by either the bicoronal or direct open-excision method. The endoscopic approach also provides adequate exposure of the tumor for excision of soft-tissue and bony tumors in the forehead area. It is a safe procedure with a 'scar-less' result.

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內視鏡輔助切除前額腫瘤

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背 景：由於醫療水準的進步，病人期待的治療效果也愈高。近年來內視鏡手術在整形外科界也引起廣泛興趣而日益發展，藉由內視鏡小切口、復原快的優點，我們將此技術運用在前額腫瘤的切除。

方 法：在前額髮線內做兩個縱向約1.5公分的切口，一端放入4.0毫米30度角的內視鏡，一端放入內視鏡專用的剪刀或剝離器，對於軟組織瘤經由帽狀腱膜下做剝離，而對於骨瘤則採用經由骨膜下剝離。藉由內視鏡放大影像的效果，可清晰避免神經血管的傷害而完整地將前額腫瘤完全切除。術後傷口縫合後不須放置引流管，亦不須壓迫性包紮即可當日出院。

結 果：運用此術式於7例前額良性腫瘤的病人，其中3例爲皮下囊腫，2例爲脂肪瘤，2例爲骨瘤，所有病人的前額腫瘤均得以內視鏡手術將其完全摘除，術後平均追蹤時間爲7個月，術後並無任何感染、血腫、頭皮發麻等併發症發生，而病人及其家屬均滿意此種手術的結果。

結 論：以內視鏡輔助手術摘除前額腫瘤，不僅手術切口小，且能隱藏在髮際之內，復原期短，對於欲尋求摘除前額腫瘤的病人而又不想在臉上留下任何手術記號「疤痕」，這種術式提供了另一種良好的選擇及結果。

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關鍵字：內視鏡，前額腫瘤。

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