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Minimally invasive surgical techniques in oral & maxillofacial surgery

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Abstract
Minimally Invasive Surgery also referred as endoscopic surgery, less invasive surgery, video-assisted surgery, telescopic-surgery and minimal-access surgery. It is the discipline of surgical whichallows for direct visualization through natural orifices or smaller incisions that are distant to the surgical site. Advances in technology allow for the development of smaller endoscopes and endoscopic instruments for operations in the maxillofacial region. Minimally invasive surgical techniques has been well accepted and requested by patients because of the decreased morbidity, shorter hospital stay, and quicker return to normal function, as compared with standard, maximally invasive techniques.

Keywords: maxillofacial surgery, endoscopic surgery, less invasive surgery

Introduction

The first publication on arthroscopy (then called "Arthro-endoscopy") came from Dr Eugen Bircher [1] who used a laparoscope in a knee joint using nitrogen gas to distend the optical cavity. Oral and maxillofacial surgeon, Masatoshi Onishi, was first to perform temporomandibular joint (TMJ) arthroscopy using an arthroscopy developed by Masaki Watanabe, a Japanese orthopedic surgeon. Since then, oral and maxillofacial surgeons, Onishi, Holmlund, Murakami, McCain, and Sanders, have further popularized TMJ arthroscopy and are considered the pioneers of this field. Interest in the minimally invasive approach to the ramus condyle unit (RCU) began in the late 1990s and early 2000s with Lee, Mueller, Schmel-zeisen, Kellman, and Troulis Natural orifice surgery was introduced in the 1990s, as Konisgsberger, Nahlieli, Katz, and Marchal applied endoscopy to enter the salivary ducts to treat salivary gland obstruction.

Minimally invasive surgery offers faster recovery, fewer complications, and shorter hospital stay. An experimental study on Yucatan mini pigs compared the postoperative edema associated with transoral vertical ramus osteotomy to endoscopic-assisted vertical ramus osteotomy using a small submandibular incision and found that the endoscopic approach resulted in less postoperative edema at 24 hours postoperatively. Small incisions with minimal tissue manipulation may allow for faster recovery and reduced postoperative discomfort when compared with traditional surgical techniques [2, 3].

Minimally Invasive Surgical Techqniques in Orthognathic Surgery

Minimally invasive orthognathic operations have several advantages over traditional open techniques. The use of endoscopy allows direct visualization of a magnified and illuminated operative field while requiring only small and remotely placed incisions in inconspicuous locations [3]. The use of endoscopy allows direct visualization of a magnified and illuminated operative field while requiring only small and remotely placed incisions in inconspicuous locations. Tissue dissection and manipulation are minimized, resulting in less postoperative pain, edema, and overall morbidity when compared with that of open approaches.

The three most common minimally invasive mandibular orthognathic procedures include:

Endoscopic vertical ramus osteotomy (EVRO): an alternative to the traditional intraoral vertical ramus osteotomy and the sagittal split osteotomy for treatment of mandibular prognathism or asymmetry [4, 3, 5].

The endoscopic vertical ramus osteotomy (EVRO) is a minimally invasive alternative to the IVRO (INTRAORAL VERTICAL RAMUS OSTEOTOMY) and BSSO (BILATERAL SAGGITAL SPLIT OSTEOTOMY) for treatment of mandibular prognathism. In addition to the general advantages of a minimally invasive technique, the EVRO allows use of rigid internal fixation with an osteotomy similar to that in the IVRO, thereby minimizing risk to the inferior alveolar nerve. This technique also allows mandibular setback without the need for mandibular third molar extraction. Indications for EVRO include patients with mandibular prognathism

with or without asymmetry who opt for surgical correction but prefer to minimize risk to the inferior alveolar nerve and who refuse postoperative maxillomandibular fixation [4].

Endoscopic access to the ramus condyle unit for treatment of congenital or acquired temporomandibular joint diseaserequiring either condylectomy alone or in combination with costochondral grafting (e.g., idiopathic condylar resorption or condylar hyperplasia) or construction of a ramus/ condyle unit (e.g., hemifacialmicrosomia) [2, 6]. landmarks include the posterior border of the mandible, sigmoid notch, coronoid process, anterior border, and posterior mandibular body.

Mandibular Asymmetry Secondary to Condylar Hyperplasia Mandibular asymmetry secondary to condylar hyperplasia is another condition amenable to minimally invasive treatment. Condylar hyperplasia is the most common postnatal growth abnormality of the temporomandibular joint.

DO (Distraction Osteogenesis) alone or in combination with endoscopic access

Used to correct mandibular retrognathism or asymmetry as a substitute for the traditional sagittal split osteotomy or acute advancement and bone grafting [7, 8] Minimally invasive approaches to the paranasal sinuses and the craniofacial skeleton above the mandible have been employed since the introduction of trans-nasal endoscopic sinus surgery in the 1970s [9, 10].

Endoscopic maxillary orthognathic surgery is a relatively new concept. This technique has been successfully used to perform Le Fort I osteotomies for the correction of maxillary deformities [11-15].

Endoscopic Treatment of Subcondylar Fractures—Intraoral Approach

The traditional intraoral approach for open reduction and rigid internal fixation (ORIF) of subcondylar fractures, first described by Steinhauser in 1964, and later detailed by Jeter et al in 1988, has been modified multiple times. The general concepts of treatment and strategies for execution are similar. The patient is placed into maxillomandibular fixation (MMF) [16].

An intraoral incision through the mucosa, and periosteum extends over the external oblique ridge. After exposing the lateral ramus from sigmoid notch to the mandibular angle, the surgeon can identify the fracture and the proximal fragment. If medially displaced, the surgeon manipulates the condyle laterally while pulling the mandibular angle inferiorly. Atrocar is inserted precutaneously in the preauricular region over the fracture site. A hole is drilled through the trocar into the proximal fragment. Tightening of the first screw into the proximal segment occurs through the trocar with the plate held in place intraorally. A second hole is drilled in the distal fragment and the remaining screws placed. After removal of rigid MMF and confirmation of occlusion, the patient uses training elastics, maintains a soft diet, and performs range of motion exercises. Descriptions of minor modifications to this technique and regimen exist [17-19].

Although apparently advantageous due to minimal scarring and decreased risk of facial nerve damage, the traditional intraoral technique presents multiple difficulties in execution. Visibility and manipulation are impaired, especially in a medially displaced proximal segment or high condylar neck fracture. Little data exists on the clinical and radiographic outcomes of this method. In one case series describing intraoral ORIF as "technically simple," satisfactory reduction of the condyle occurred in only 80% of patients, and only in nondislocated fractures. Even though range of motion returned to normal, 23% of patients' jaws deviated to the fractured side on maximal opening. These results point to the difficulty in reducing sub- condylar fractures using the standard intraoral approach. Most clinicians therefore limit their use and recommendation of this technique. The standard approach to fractures in this region involve the use of preauricular, submandibular, or retro-mandibular incisions [20].

Endoscopic Surgery of the Paranasal Sinuses

In the early 1900s, Hirschmann described the first endoscopic evaluation of the nose and paranasal sinuses. However, this was not widely accepted due to inadequate visualization and instrumentation. The Caldwell-Luc procedure remained the treatment of choice for chronic sinusitis. In the 1960s, Hopkins developed rod telescopic lenses, which greatly increased the light intensity and improved the overall resolution. With the development of endoscopes, Messerklinger was able to describe the anatomy of the paranasal sinuses and the pathophysiology of diseases affecting these regions. In the 1980s, Stamberger and Kennedy applied these principles and developed endoscopic surgical techniques.[21] Over the last 30 years, functional endoscopic surgery has become the standard of care for the treatment of inflammatory diseases involving the paranasalsinuses. Its role in the management of sinonasal and skullbaseneoplasms continues to expand due to advances in equipment, imagingmodalities, and navigation software. Functional endoscopic sinus surgery is predicated on the notion that chronic sinus disease can be reversed if the sources of obstruction at the outlet of a sinus can be removed. The mucosa of the obstructed sinuses can return to normal function if proper aeration and mucociliary clearance are re-established.[22]A thorough understanding of the complex anatomy of the paranasal sinuses and proper identification of surgical landmarks are paramount for safe and successful endoscopic surgery.

Endoscopy in Orbital Floor Fractures

Though the endoscopic diagnosis and treatment of the craniomaxillofacial region has expanded tremendously over the past decade [23] the application to the area of orbital injuries is perhaps most justified, due to the potential morbidity of current treatment philosophies and methodologies. Orbital fractures may involve any of

the bony components, including the medial and lateral walls, roof, and floor, yet due to its inherent weakness, orbital floor fractures are most common.[24]The orbital rim is composed of dense compact bone that does not fracture easily. Although the orbital wall thickness varies, and the medial wall is usually thin, the intricate network of ethmoidal air cells and bony trabeculae provide support to the medial orbital wall, yet medial wall fractures do occur often [25]. Orbital fractures may present with a range of signs and symptoms, including periorbital edema and ecchymosis, chemosis, ptosis (which can make further examination difficult), lacerations, decreased visual acuity, visual field defects, canalicular disruption, decreased extraocular muscle movement (entrapment or paresis),diplopia (in certain fields of gaze), ophthalmoplegia, abnormal pupillary response to light and accommodation, subconjunctival hemorrhage, proptosis, enophthalmos, increased intraocular pressure (retrobulbar hemorrhage),corneal abrasions, retinal disruption, lens disruption, hyphema, and possibly paresthesia of the supraorbital, infraorbital, and supratrochlear nerves.

The use of endoscopy for orbital floor repair may provide an excellent option for treatment that obviates the need for periorbital incisions and significantly decreases postoperative morbidity. In addition, the endoscopic technique can allow visualization of the entire orbital vault, especially the posterior compartment, which is usually difficult with direct visualization due to prolapsed orbital contents, edema, and bleeding. The use of endoscopy for orbital floor repair is not a new concept, and it was described in 1901 using a modified cystoscope.[26] The transantral approach to the orbital floor was described in 1972 using indirect illumination, manual fracture reduction, and short-term sinus packing to provide support for the comminuted orbital floor.[27] With the introduction of functional endoscopic sinus surgery in 1985 [28] the connection was made clear to apply this technology to the midface for other applications, such as fractures. Throughout the past two decades there were several descriptions of endonasal approaches to the orbit; however, these provide only limited access and, therefore, these techniques were not adopted by most surgeons due to inherent technical difficulties [29-32] As a result, many surgeons have employed the Caldwell-Luc approach to the orbit through the maxillary sinus with endoscopic assistance in order to achieve wider surgical access and improved visualization of the orbital floor (and medial orbital wall in some cases) and to provide optic nerve decompression, when indicated [33-36] In a comparative cadaveric study of endoscopic transantral versus transconjunctival repair of orbital floor fractures, there were no statistically significant differences between post-repair CT volumetric analysis. Furthermore, this study confirmed the efficacy of endoscopic-assisted repair of orbital floor fractures [37] This technique has several advantages including the use of a simple standard transmucosal approach to the anterior wall of the maxillary sinus;the use of a standard Caldwell-Luc antrostomy, which may be modified in size to accommodate materials needed for floor repair (eg, Medpor or titanium mesh); the development of a large “optical cavity” (ie, the entire maxillary sinus) for access and visualization; minimal bleeding following the use of local topical hemostatic measures and drying agents; demucosalization of the sinus lining for visualization of all fracture segments; and effective control of the periorbital tissues and fat. In addition, this approach provides unparalleled visualization of the posterior shelf of the orbital floor, including the orbital foramen, if necessary; access to the medial orbital wall is possible as well in the case of fracture; ease of surgical placement of floor replacement material, if necessary; lack of a skin or transconjunctival incision and avoidance of resultant morbidity ; significantly decreased postoperative edema when compared to transfacial approaches; and, overall better surgical access, exposure, visualization, and treatment of the orbital floor fractures.

Frontal Sinus and Zygomatic Complex Fractures

Endoscopic Procedure for Frontal Sinus Fracture Repair The instruments and the technique for frontal sinus fracture repair are similar to that for endoscopic forehead lift. Two hairline incisions are made after injection of local anesthesia (1% lidocaine and 1:200000 epinephrine). The incisions are 1 cm to 2 cm long and located 2 cm to 3 cm behind the hair line. In patients with a prominent forehead or a receding hair line, the incisions should be closer to the hair line, to allow better visualization around the curvature of the forehead. Two separate ports are used for access and instrumentation: visualization port for the endoscope and working ports for the instruments. A 4 mm diameter, 30-degree angle Hopkins II endoscope (Karl Storz, Tuttlingen, Germany) with an external sheath for retraction of the soft tissue is used for this operation. The sheathed retractor has an overhang over the lens and a locking metal tube for the endoscope, which allows simultaneous movement of the retractor and the endoscope during the dissection of the optical cavity [38].

Conclusion

Endoscopes are revolutionary surgical tools that provide detailed video images, allowing visualization of internal structures, basically endoscope consists of two fiber optic lines-LIGHT FIBER, carries light into body cavity and an IMAGE FIBER carries the image of the body cavity back to Physician’s viewing lens In recent times it has been gaining wider acceptance in various surgical fields, Application of this minimally invasive procedures is being implemented for the promotion of providing assistance to the operating surgeon to imagine the field through the endoscope and instruct considering the surgical maneuvers on the monitor, without obstacle to observe, lesser operative trauma, bloodless surgery, less complications through minimal incisions, less hospitalization time, Lower pain and scarring, fastened rehabilitation and reduced post-surgical complications.

In the domain of Oral and Maxillofacial Surgery, applications of endoscopy is being carried out in various procedures such as Arthroscopy of TMJ, Mandibular Condylar Fractures (Endoscopic-assisted open reduction and internal fixation), Orbital Fractures, Zygomatic Fracture (Transantral Endoscopic Technique),Thyroid

Surgery (Robotic Transoral Technique), Sinus Surgery (Functional Endoscopic Sinus Surgery), Cosmetic Surgery-Brow and Mid facelift procedures, Assisted Surgery in Implant Surgery, Cleft surgeries (Nasoendoscopy), Head and Neck Oncology (Contact endoscopy, Trans Oral Endoscopy), In Orthognathic surgery(Pre surgical mandibular leveling).

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