Review Article

Minimally invasive (endoscopic-computer assisted) surgery: Technique and review

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ABSTRACT

Endoscopic or minimally invasive surgery popular as keyhole surgery is a medical procedure in which endoscope (a camera) is used, and it has gained broad acceptance with popularity in several surgical specialties and has heightened the standard of care. Oral and maxillofacial surgery is a modern discipline in the field of dentistry in which endoscopy has developed as well as widely used in surgeries and is rapidly gaining importance. The use of different visual as well as standard instruments such as laparoscopic and endoscopic instruments, and high-powered magnification devices, has allowed physicians to decrease the morbidity of many surgical procedures by eliminating the need for a large surgical incision. Minimally invasive techniques have evolved through the development of surgical microscopes equipped with a camera to get visual images for maxillofacial surgeries, endodontic procedures, and periodontal surgical procedures. Nevertheless, current experiences and reviewing the literature have intimated that the use of endoscopes, as in different minimally invasive methods, may permit complicated surgeries with less complications, for example, in reconstruction of facial fractures through smaller incisions with less extensive exposure.

Keywords: Endoscopic, fractures, minimally invasive, surgery

INTRODUCTION

Oral and maxillofacial surgery is enrolling an innovative era in the twenty-first century and getting a worldwide recognition. Surgeons can apply the newest technology, newly developed equipment in an effort to promote patient postsurgical consequences with bloodless surgery. Minimally invasive surgery with the application of the different types of endoscopes has developed in modern years in consequence of technological improvements in maxillofacial surgical procedures and associated instrumentation. Trauma, orthognathic surgery, sialoendoscopy, and temporomandibular joint (TMJ) disorders in oral and maxillofacial surgery are usually performed with the support of the endoscopes.[1] From an educational point of view, surgical anatomy and various different principles can only be explained to maxillofacial trainees with the support of the endoscope. Hence, on the basis of this, we can use a new term as minimally invasive dentistry in the 21st century. Minimally invasive techniques should also be used in combination with scalpel for easier surgery with fewer complications. Application of endoscopic techniques in various surgeries is now approaching deeper parts and still under experiments.

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In consequence of the fact that past 150 years, mortality and morbidity for each and every surgical operation have been tacitly admitted as inevitable parts of the therapeutic process. In early 1980s, it had become evident that less invasive methods of interventional treatment in some areas have produced fewer complications with a reduced risk of death and morbidity. More and more surgical and radiological procedures are being reevaluated worldwide with a view to reduce operative trauma and complications. Minimally invasive dentistry is a logical concept in which the purpose of arbitration is to preserve healthy tooth structure. Minimally invasive dentistry approaches the treatment objective using the minimally invasive surgical process, with the elimination of the minimal quantity of healthy tissues.

The operating surgeon can imagine a field through the endoscope and instruct considering the surgical maneuvers on the monitor, without obstacles to observing. The indicated technique also provides others in and out of the room to inspect the picture. Endoscopically assisted surgery is obtaining notoriety and is becoming a tool commonly applied by surgeons to assist in and simplify a bit of the various complicated procedures that often feel the necessity for more comprehensive surgical exposure for visualization.

The concept of applying instruments to examine inside a cavity not promptly accessible to inspection can be followed back approximately 2500 years. It has been reported that endoscopy began in the fourth century BC when Hippocrates used a speculum to examine the rectum of a patient.[2] Written descriptions of gynecologic speculums can be found in the Babylonian Talmud.[3] Indeed, many of the early advances and techniques in endoscopy are attributed to practitioners of this specialty.[4]

Arthroscopy began in the early twentieth century and was first used by Tagaki in 1918 to examine and describe the knee joint.[5,6] In 1921, Bircher published the results of his use of a Jacobaeus laparoscope to perform knee arthroscopy.[5,6] Today, arthroscopy is used routinely by orthopedics and maxillofacial surgeons. The laparoscope techniques are routinely used for the diagnosis of cancer and also used in the treatment of endometriosis, pelvic pain, ectopic pregnancy, and ovarian cysts or tumors, as well as for tubal ligation.

Minimally invasive surgery should be enforced for lesser operative trauma for the patient than a commensurate invasive procedure. It may be more or less costly. The operative period is longer; however, hospitalization time is smaller. It produces lower pain and scarring, speeds rehabilitation, and decreases the rate of postsurgical complications, such as adhesions.

ARTHROSCOPY OF TEMPOROMANDIBULAR JOINT

TMJ arthroscopy is a surgical method that is performed on the TMJ or jaw joint [Figure 1] that includes applying a camera to see within the circumference of joint and clean the joint. Arthroscopy is a technique for direct visual inspection of internal joint structures, including biopsy and other surgical procedures performed under visual control. In 1918, Tagaki first described arthroscopy of the knee joint examinations using cystoscope (Tag, 1939). Onishi, in 1970, was the first to report arthroscopy of the human TMJ, and the first results were published by him (Onishi, 1975, 1980).

Robotic transoral technique, one of the endoscopic techniques used in thyroid surgery, has been proven to be feasible in most cadavers and porcine models and in patients. The approach combines the advantages of a "scarless," remote access incision with the goals of minimally invasive surgery. Unfortunately, current instrumentation and technology make this approach technically difficult and place unacceptable risk on the mental nerve.

ENDOSCOPY IN SINUS SURGERY

Revision sinus surgery for inflammatory diseases of maxillary sinus has been revolutionized by endoscopic techniques used in maxillary sinus surgery [Figure 2]. Clinical trials have shown statistically significant positive outcome data for patient symptoms and quality of life, as well as improvements in objective findings on postoperative nasal endoscopy and computed tomography (CT) imaging for patients undergoing revision sinus surgery. The keys to successful revision surgery are adjunctive medical management, aggressive postoperative debridement, mucosal preservation, and removal of osteitic bone. Both the physician and patient should also understand the underlying disease process and comorbid factors so that anticipated postoperative outcomes can be met with realistic expectations.

Mucosal protection is of supreme importance in the analysis and surgical management of the sinonasal or paranasal region. The endoscope remodeled the application of endoscopic nasal surgery. As a consequence, external sinus surgery is conducted not so much as frequently today, and major emphasis is placed on functional endoscopy conservation of normal anatomy. Endoscopic surgery of the nose and paranasal sinus has provided improved surgical outcomes and has shortened the length of stay in the hospital. It has also become a valuable teaching tool.[7]

It basically aims to restore:
1. Sinus ventilation
2. Reestablish mucociliary clearance
3. Maintain healthy sinus mucosa.

For sinus surgery, most widely used endoscope is 4.0 mm diameter rigid endoscope. It provides different angles of vision in maxillary sinus from 0° to 120°.

Benefits of this technology includes:
1. It allows good visualization of ostium, osteomeatal complex, and complete sinus anatomy itself
2. It is safe and feasible
3. Surgical field is also better visualized
4. Cosmetic benefits.

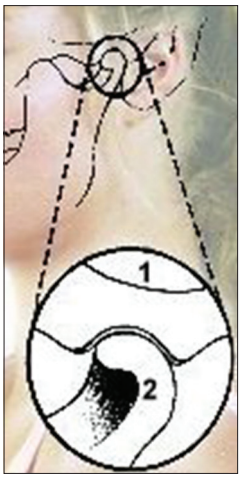

Figure 1: Endoscopic view of temporomandibular joint

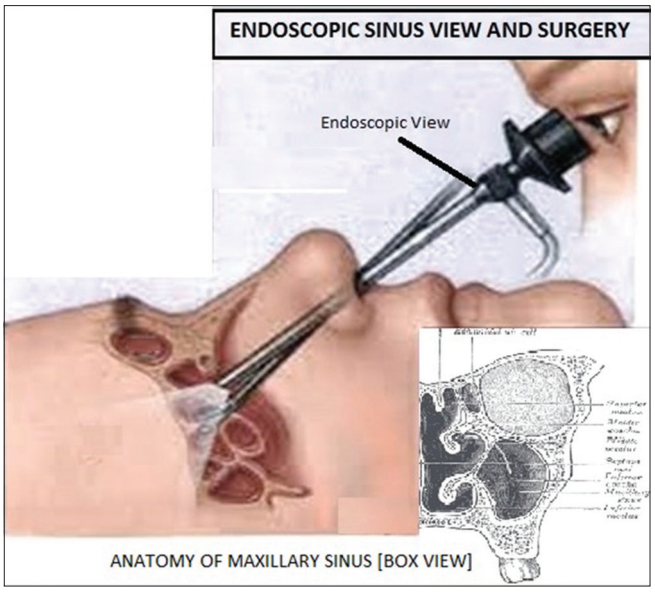

Figure 2: Endoscopic view of maxillary sinus

USE OF ENDOSCOPY IN BROW AND MID FACELIFT PROCEDURE

Facial cosmetic surgery has three goals: to recreation, to reinvigoration, and improvement. Recreation means reinstatement or reconstruction of a previous, normal, or uninjured state. Reinvigoration is the reinstatement or reconstruction of a young, fresh, new appearance. Improvement is the position of having been made better, enhanced, or augmented, as in condition, attractiveness, and so ahead. The endoscopic brow and mid facelift magnify the capabilities of the cosmetic facial surgeon to achieve the aforementioned three goals. In summation to these goals of cosmetic surgery, there are two very essential thoughts that also have emerged with the rise of advanced technology. The initial purpose is to work from the inside out whenever feasible. The next idea is to reposition or augment, before extracting tissue. Esthetic outcomes are more consistent and last longer just as soon as the indicated ideas are scrutinized.

ENDOSCOPY IN ORBITAL FRACTURE

The endoscopic method was rapidly developed to midface and total facelifts. Advantages have incorporated more esthetic area of the incisions, smaller scars, improved hemostasis, protection of the innervation with magnified visualization, and smaller convalescence period. The clinical application of the endoscope to repair zygomatic fractures was reported by Kobayashi *et al*.[8] in 1995, which stimulated interest in using endoscopy to treat fractures in facial trauma patients. The transantral endoscopic technique is indicated in isolated orbital floor blowout fractures with or without infraorbital fractures or in orbital floor fractures in conjunction with medial orbital wall fractures or simple zygomatic fractures.

As endoscopic orbital surgery, a modicum of instrumentation is required. The necessary video setup is identical as in other endoscopic methods, incorporating a video monitor, an endoscopic camera (charged couple devices ½CCD chip camera), a high-quality light source, a videocassette recorder, and a video printer. Currently, the endoscopic technique has evolved to include the orbital region, including repair of orbital medial wall and floor defects and optic nerve decompression.

Minimally invasive techniques help maxillofacial surgeons properly visualize and observe the orbit fractures including soft tissue of the posterior orbit to precisely reduce fracture and place implants and protect vital structures.

USE OF ENDOSCOPY IN MANDIBULAR CONDYLE FRACTURE

The entire history of open reduction and internal fixation (ORIF) of bone fractures can be ascertained to the twentieth century. The historical development of operative surgery of maxilla-facial fractures has emerged through several phases during the aforementioned period. Beginning in the centenary, closed treatment of maxillofacial facial fractures remained pervasive.

The application of the endoscope to treat condylar injuries was a natural continuation of minimally invasive procedures for handling craniomaxillofacial trauma. Most surgeons believe on an intellectual level that fracture reduction and rigid fixation with the restoration of anatomy are commendable goals if that can be achieved without undue morbidity.

Endoscopic assistance surgery allows the surgeon to produce anatomic fracture alignment and to avoid the negative sequelae of condylar malunion. Endoscope-assisted (ORIF) minimal invasive procedures have been taking extra part in the head and neck soft tissue and maxillofacial trauma surgery. The reduction in morbidity linked with the endoscopic-assisted surgical method may expand the indications for reduction and rigid fixation in the future.

The cost of instruments and technical difficulties are the main constraints of endoscopic procedures.[9] Proportionately operating surgeon should decide on his or her implications in consequence

of the fact that endoscopic-assisted surgery should perform, and finally, this may depend massively on his or her experience and patient preference.

USE OF ENDOSCOPIC-ASSISTED SURGERY IN IMPLANT SURGERY

The endoscopic surgical approach has been used for the removal of the maxillary supernumerary tooth, impacted third molar, and implants. In a case report presented by Beltrán *et al*. in the year 2014, they present an endoscopically assisted surgical technique for the removal of an unerupted supernumerary premolar in the mandible associated with a dental implant placement procedure.[10,11] They also stated that support of endoscopic techniques in surgical techniques makes minimally invasive with less complications such as less tissue damage, greater conservation of bone, etc. Suarez-Cunqueiro *et al*.[12] reported the first case of an endoscopic surgical technique by the support of endoscope for the removal of an ectopic third molar in the condylar process of the mandible associated with a dentigerous cyst.

SOME OTHER USES OF ENDOSCOPY-ASSISTED SURGERY

Endoscopically assisted control after transoral fracture reduction can be performed in areas of limited visibility such as the inferior and posterior aspect in mandibular angle fractures and in fractures of the ascending ramus. The result is controlled endoscopically to avoid dislocation at the inferior and posterior aspect of the mandible and to prevent lingual gaping intraoperatively. The endoscopically assisted technique proves to be practical for the removal of osteosynthesis material being inserted by way of the extraoral approach.

ENDOSCOPY IN PROSTHODONTIC MANAGEMENT

Telescopic oral endoscopy is an effective aid in the construction and modification of the speech help prosthesis. The method is noninvasive and easy to perform and permits the prosthodontist to achieve the goal of functional effectiveness in prosthesis construction while keeping the weight and size of the pharyngeal extension at a minimum. It also decreases the number and length of patient visits required for modification, and when coupled to a fiberoptic teaching arm or a video camera and recording system. Oral endoscopic is an excellent aid in teaching, patient education, and orientation, and record is keeping.

In a case report published by Satwalekar *et al*. in the year 2013, they used endoscopic technique for the retrieval of dental implant from maxillary sinus.[12]

INTERVENTIONAL ENDOSCOPY

In an endoscopic procedure, physicians can look inside the body without an incision. The instruments used are an endoscopy tube with the attachment of high-resolution camera is inserted directly into an organ through one of the body's openings (e.g., the mouth, nose, rectum, or vagina).

ACHALASIA

Endoscopic treatment for achalasia is centered on intruding or softening the lower esophageal sphincter. The three conventional treatment alternatives for achalasia are surgical myotomy, pneumatic dilation, and botulinum toxin injection. Pneumatic dilation yields results that are usually safer than botulinum toxin injection and may address a clinical rejoinder comparable with surgery. Per oral endoscopic myotomy is a newer endoscopic modality that will likely change the treatment paradigm for achalasia.[13]

IMAGE-GUIDED SURGERY

A variety of procedures can soon be performed utilizing radiographic-guidance, involving interventional radiology, cardiac organ valve surgery, aneurysm stenting, and ablation of neoplasms.

The progress of devices for image-guided surgery and treatment has led to the necessity for an environment to correctly interpret the patient using computer-assisted techniques, to fabricate surgical and therapeutic techniques in as faithful a manner as feasible, without affecting humanly. The indicated procedure becomes individually important as surgical methods develop into minimally invasive and robotically assisted.

In nearly all surgeries, the physician undeviatingly implements the surgical operation with the cooperation of conventional surgical tools in addition with off-line CT images and probably with fluoroscopic images that give the on-line situation of current surgical methods for the patient. However, the surgical method commonly entails accurate operational abilities and intuition of the physician. At times, insignificant mistakes or misjudgments during a surgical operation could occur in unrecoverable damages to patients.[14]

LAPAROSCOPIC PROCEDURES

The most common type of minimally invasive surgery uses small incisions in the abdomen [Figures 3 and 4], each about a half inch long, to insert a laparoscope (a specialized camera) and surgical instruments. The laparoscope sends digital video to a monitor, which the surgeon uses as a guide during the operation.

ROBOTIC-ASSISTED SURGERY

The minimally invasive robot technology is invented to give surgeons with enhanced abilities, encompassing the breakthrough visualization, accuracy, and control. The robotic system acts by turning surgeon's hand movements on the robotic control mechanism into over and above precise movements of the miniaturized instruments that are injected into the body.

The transoral robotic method allows surgeons to operate from within a patient's mouth, bypassing external incisions in the neck and jaw that can drop an individual with persistent scarring and complications in eating, speaking, and swallowing.

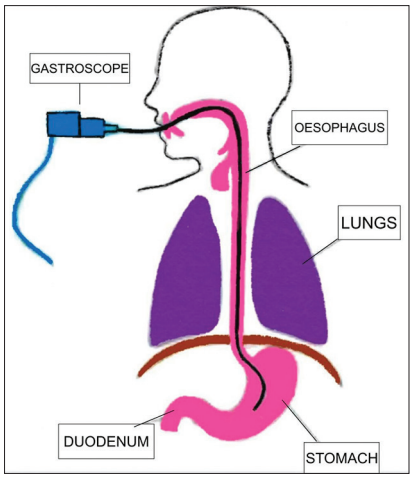

Figure 3: Endoscopic instrument in diagnosis

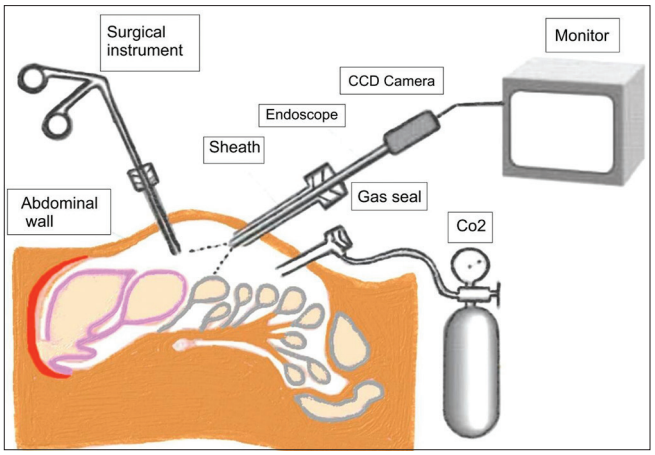

Figure 4: The detailed view of endoscopic setup during surgery

CONCLUSION

Endoscopically assisted supervision of maxillofacial trauma has been reported as the treatment of the mandibular condyle fractures, zygomatic complex fractures, orbital fractures, and frontal sinus fractures. Albeit the surgical management for open reduction and fixation of fractures by miniplate osteosynthesis has not replaced, endoscopically assisted procedures make it desirable to limit incisions and to have raised intraoperative control over fracture reduction in regions of restricted exposure and visibility.

Many medical procedures are called minimally invasive-assisted surgery, such as hypodermic injection, subdermal implants, percutaneous and laparoscopic surgery, arthroscopic surgery, cryosurgery and microsurgery, endovascular surgery (such as angioplasty), stereotactic surgery, radioactivity-based medical imaging methods, positron emission tomography, and single-photon emission tomography. Analogous methods are image-guided surgery, robotic surgery, and interventional radiology.

Minimally invasive surgery should be compelled less operative trauma for the patient than a commensurate invasive procedure. It may be more or less costly. The operative period is longer; however, hospitalization time is smaller. It produces lower pain and scarring, speeds rehabilitation, and decreases the rate of postsurgical complications, such as adhesions.

The goal of endoscopic-assisted surgery or minimally invasive surgery is to conserve health, reduce surgical trauma, increase flap/wound stability, allow stable primary closure of the wound, reduce surgical chair time, and minimize patient discomfort and side effects, and the technique requires a core team of endoscopic and specially instructed surgeons.

Future prospects

It can be expected that computer-aided surgery will significantly commit to promoting the quality of life of the patients. Several of minimally invasive systems described aforementioned have demonstrated great promise in improving safety, accuracy, and clinical outcome while decreasing operative times and complication rates. If aforementioned goals are achieved, minimally invasive systems or computer-assisted surgery have the potential to be both cost-effective as well as medically desirable. However, as time moves and technology proceeds to be refined, it is predicted that computer-assisted surgery will play ever increasing roles in precise and accurate techniques such as those required for percutaneous access. Now, if we classify endoscopic techniques on the basis of literature review, we can classify all the endoscopic instruments in three types which are as follows:

Capsule endoscopy

Nowadays, it is also in used by means of a capsule placed with a tiny camera inside it. The tiny camera takes the images, and later, the image can be viewed on image viewer or computer.

Visual endoscopy

The endoscopic techniques used to visualize and identify the pathology with affected organ. For example, colonoscopy and sigmoidoscopy used to screen the colon and rectal cancers.

Surgical endoscopy

The rest all endoscopic instruments used in surgery can come under this classification. For example, arthroscopy, laryngoscopy, cystoscope, mediastinoscope.

Drawbacks are least like it takes more time in operating room and also it requires more medicines to keep patient asleep.

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Conflicts of interest

There are no conflicts of interest.

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