SURGICAL ORTHODONTICS – A REVIEW

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ABSTRACT-
The article examines several frequently utilized orthodontic methods as well as innovative approaches to help correct malocclusion. Various techniques are often employed alongside surgical procedures and serve as an essential complement to orthognathic surgery. A fundamental understanding of these approaches will enhance the surgeon's capability to effectively treat the patient.

Numerous orthodontists and surgeons are opting to forgo presurgical orthodontics in favor of a 'surgery first' model in orthognathic surgery. This method offers the advantage of immediate enhancement in facial appearance and reduced treatment duration. The emergence of virtual surgical planning has made it easier and quicker to implement this new approach. Additionally, the use of intraoperative surgical navigation is enhancing accuracy and overall results.

Keywords

malocclusion, orthodontics, orthognathic

INTRODUCTION-

Malocclusion can be treated with various orthodontic and surgical approaches. Occasionally, it is essential to integrate these methods to achieve the best overall results. It is crucial for orthognathic surgeons to be aware of the supportive orthodontic treatments being executed to attain optimal outcomes. Additionally, comprehending the constraints of each discipline is vital for achieving an ideal final result and ensuring a positive experience for the patient.
An essential concept to understand is the distinction between orthodontic and orthopedic forces. When gentle orthodontic forces are applied, the periodontal ligament continues to receive adequate blood flow and oxygen, facilitating favorable dental changes. Conversely, when stronger orthopedic forces are exerted, there is a risk that the blood supply to the periodontal ligament may be compromised if not managed appropriately. This leads to alterations in the skeletal structure as orthopedic forces impact the magnitude and direction of bone growth, thereby hindering dental adjustments. Depending on the type of malocclusion present in a patient, a range of orthodontic and

orthopedic modifications may be necessary to correct the deformity. This article describes several methods that orthodontists can utilize to help correct malocclusion through surgery. These techniques can be employed either in advance of orthognathic surgery or as an addition to surgical treatment.

TEMPORARY ANCHORAGE DEVICES

Temporary anchoring devices (TADs) have emerged as an alternative to intraoral anchorage methods such as the lingual arch, the nance application, and interarch elastics, as well as extraoral headgear [1]. In order to enhance tooth mobility, a titanium alloy or stainless steel miniscrew is attached to the palatal or alveolar bone [2]. Depending on the clinical scenario, TADs can have varying diameters and lengths, and the screw's head can be either a post or a flat top [2]. Local anesthesia can be used to insert the implant transmucosally in the office and secure it to the bone endosteally, subperiosteally, or trans-osteally [3]. The screws are very helpful for orthodontic intrusion of teeth, which might assist fix an anterior open bite caused by early molar contact, for instance. TADs are useful for more consistent treatment of occlusal cants and provide complete anchoring when reciprocal movement of teeth is not appropriate [1,2]. After the placement aim is achieved, the implant is taken out. The implant breaking or loosening, infection, tooth root injury, intrasinus implantation, and mucosal overgrowth are among the risks associated with this approach [1, 2, 4].

FUNCTIONAL APPLIANCES

In an effort to prevent surgery later in life, functional appliances may be used when a bone anomaly is discovered early in childhood. Functional appliances, by definition, use the patient's own muscular activity to generate orthodontic or orthopaedic stresses.
The most often used fixed functional appliance is the Herbst appliance. In patients with class II malocclusion and retrognathia or micrognathia, it is utilized to help stimulate the subcondylar growth center, which in turn promotes the formation of new bone [5–7]. The device is worn around the clock and is affixed to the upper and lower molars. By doing this, the compliance problems that come with detachable devices are avoided. On the buccal surface, a piston is positioned tangential to the mandibular dentition and attached to the upper and lower fixation points.The relative maxilla-mandibular posture may be controlled by adjusting this piston, which eventually pulls the jaw forward to promote the formation of new bone. The growth of the lower jaw is primarily responsible for correction, even though the pressure on the maxilla helps move the teeth distally to assist correct class II malocclusion [8,9]. Although the appliance is best utilized in the permanent dentition, it may also be used in mixed or deciduous dentition by employing a bonded device or by attaching the appliance to a permanent canine [8]. Research has demonstrated little recurrence of effect over time and strong durability of treatment effects [10,11].

PALATAL EXPANSION

Palatal expansion is a predictable treatment for posterior lingual crossbite and transverse maxillary hypoplasia. The palatal suture gradually extends anteriorly before closing posteriorly. By the ages of 13 for women and 15 for men, it is thought to have fully closed. Age is not a reliable indicator of when the palatine and maxillary sutures will close, according to recent findings utilizing cone beam CT [12]. As a result, imaging could be useful in identifying the course of action for individuals who require transverse expansion. The first phase of treatment, known as Phase I orthodontics, may involve expansion before all permanent teeth erupt, or it may be treated in conjunction with comprehensive orthodontic treatment, depending on the diagnostic and treatment objectives.

An appliance known as the quad helix expander is joined by four helices across the palate and is affixed to the upper molars. When the appliance is cemented to the molars in an active condition, a gradual and consistent expansion is produced by the springs' continuous stress across the palatal suture. Though it lacks the helices, the W-arch is a device that is quite similar to the quad helix. In a mixed dentition, both can be utilized [13]. They are ideal for usage with cleft palate patients. It has been demonstrated that these expanders are more successful in treating posterior crossbite than detachable expansion plates [14].

Rapid palatal expanders, which provide many millimeters of sutural expansion in a relatively short amount of time, are usually the expander of choice when expansion is performed as part of comprehensive orthodontic treatment in teenagers in the late mixed or early permanent dentition. An expansion screw splits the expander longitudinally along the center, and it is intended to be attached to the permanent first molars and premolars. Depending on how much extension is required, the clinician determines the size of the screws, which typically vary from 9 to 13mm. Usually, the screw is turned on one or two times every day, allowing for an expansion of around 0.25 mm each time. Until the optimal expansion is reached, the activation phase lasts two to three weeks. In order to allow for bone fill and suture stability, the device is left in the mouth for three to six months after treatment [15].

The aforementioned methods are no longer effective for expansion once the palatal suture has closed, and surgical correction may be required. Surgically aided maxillary or palatal expansion is one choice [16, 17]. This surgery involves either a unilateral or bilateral LeForte I osteotomy and the preoperative placement of a palatal expander. With distraction, the mid-palatal suture may also be split or left to separate naturally. Pterygoid plate separation may or may not be used for this [18]. Because the pterygoid plexus and internal maxillary artery branches might be injured if the pterygoid plates are detached, there is a higher chance of bleeding [19].

Some have demonstrated inadequate correction of the posterior transverse disparity in the absence of pterygoid plate separation, while others have demonstrated no difference in outcomes [20&]. There are no compelling arguments in favor of or against pterygoid plate separation [20&]. The expander is turned on 1–2 mm intraoperatively to start the expansion process. This method is stable over time and has a low rate of recurrence,

according to studies [16&17,21]. Relapse rates are often higher with Le Forte I segmental osteotomy [18,22]. After surgery, maxillary growth usually does not stabilize for 6 to 8 months [23]. Therefore, in order to avoid more serious relapse, a full-time retainer is required throughout this period.

PRESURGICAL ORTHODONTICS

In order to establish occlusal contacts, any dental compensations acquired over time must be removed before orthognathic surgery is performed to rectify jaw discrepancies. When the jaws are misaligned, the teeth will often adjust to lessen the disparity even further. Prior to surgery, the jaw position will be undercorrected if the dental compensations are not adjusted or taken into consideration. Since orthodontic adjustments will differ depending on the suggested surgical treatment, it is critical that the surgeon and orthodontist communicate throughout the planning stage. While root flaring is favored for segmental osteotomy, straightening the dental roots is helpful in inter-dental osteotomies to prevent damage to the roots [24]. Enabling optimal surgical placement of tooth segments is the ultimate objective of presurgical orthodontics. Due to dental interferences in their new location, it is challenging to precisely realign the jaws if the incisors are not positioned correctly before surgery [23]. Furthermore, by maximizing occlusal contact, appropriate presurgical orthodontic planning contributes to postoperative occlusal stability [25].

Some of the previously stated methods may be used in addition to conventional brackets and wires to achieve the required dental motions. In general, orthodontic therapy is more predictable after surgery if more correction is made before surgery. A lengthy presurgical orthodontic phase, orthognathic surgery with some postoperative stability, and a brief postoperative orthodontics time to fine-tune the occlusion are all part of the conventional strategy for comprehensive surgical-orthodontic therapy [23].

The necessity of presurgical orthodontics to attain the best results has been the subject of considerable recent discussion. Two comparable groups of class III anterior open-bite patients were compared in a 2010 retrospective study conducted by Liao et al. [26]. Presurgical orthodontic treatment was given to one group whereas it was not given to the other. They discovered that there was no discernible change in overbite, maxillary stability, horizontal mandibular stability, peer evaluation rating score, or facial aesthetics. While the opposing group's overjet was still within a normal range, the presurgical orthodontic group's was much lower. Presurgical orthodontics was shown to have a noticeably longer treatment duration. They questioned the need for presurgical orthodontics in light of this findings [26].

SURGERY-FIRST ORTHODONTICS

The idea put out by Liao et al. [26] that starting therapy with orthognathic surgery instead of presurgical orthodontics may be advantageous is supported by recent research. Nagasaka et al. originally put up the idea in 2009 [27]. The feasibility of this procedure was proven by Hernández-Alfaro et al. [28] in a prospective evaluation of 45 patients who had successfully undergone surgery-first orthodontic treatment. Before surgery, presurgical orthodontics might take up to 24 months to finish [28]. With this method, the patient's facial appearance and dental function improve right away, and treatment timeframes may be shortened [23, 25]. The patient's overall happiness is positively impacted when the general face aesthetic is surgically corrected at the beginning of therapy since facial aesthetics are frequently the patient's top concern [28, 27]. For this surgery to avoid a major recurrence in mobility, postoperative rigid rigidity is required. Additionally, the surgeon must operate on misaligned dental arches. This can complicate the procedure and need a high level of surgical expertise. Additionally, the surgeon must create an occlusion that can be resolved alone with orthodontic treatment. To guarantee an ideal ultimate occlusion, the surgeon and the orthodontist must collaborate while developing the patient's treatment plan.

In order to start therapy right away following surgery, brackets and archwires are usually positioned before the procedure [26]. In order to adjust tooth position during the post-treatment period, TADs could also be necessary. Rapid tooth movement to accomplish alignment, leveling, and synchronization is made possible by the unlocked occlusion and the absence of competing soft tissue and mucular forces [28, 29] [26]. Additionally, faster tooth movement results from increased postoperative metabolic turnover, which shortens treatment durations [28–31]. In order to facilitate tooth mobility and shorten treatment durations, some surgeons recommend conducting dentoalveolar corticotomies [28]. This method is taken from surgically assisted orthodontic therapy, in which individual teeth are surrounded by tiny holes in the cortical bone that preserve the trabecular bone. In order to accomplish tooth movement and bone remodeling, orthodontic pressures are applied soon after surgery [32]. It has been demonstrated that this yields more rapid and consistent outcomes [33]. This procedure is well tolerated, and there is moderate-quality evidence to suggest a transitory period of faster tooth movement that can be employed to induce more rapid favorable dental changes, according to a recent systematic review [32]. Recently, there has been an increase in interest in surgery-first orthodontics. With new tactics being developed to reduce overall treatment periods for orthodontics in general, the potential reduction in treatment time is particularly alluring [32, 34].

VIRTUAL SURGICAL PLANNING

When discussing orthodontic/orthognathic movement, it is necessary to consider the six degrees of freedom of the dental complex [23]. In the past, the treatment guide was created using articulator-mounted casts, hand-drawn cephalometrics, and two-dimensional radiographs. Many surgeons still employ this technique nowadays. This method has some drawbacks, such as the incapacity to handle face asymmetries and the dispersion of landmarks due to radiograph structural overlap [35]. Three-dimensional imaging and computer-assisted virtual surgical planning (VSP) have gained popularity

since computed tomography became widely available. Three-dimensional imaging is now considered the gold standard for treating severe malocclusion [23].
The use of VSP has three clear benefits. The first is that, without actually doing repeated model operations, it is simple to manipulate certain segments in various directions to envisage a variety of surgical outcomes. In an attempt to reduce condylar strain, it also enables the surgeon to see how much condylar torque is produced by the location. Finally, instead of making surgical splints from the relocated dental casts, it makes it simple for the surgeon to make anatomically adjusted surgical splints [23]. Splints based on VSP designs may now be produced using the widely accessible technology of three-dimensional printing. When compared to traditional splinting or surgical navigation, the use of computer-aided designed and made splints had the best precision for maxillary planning transfer, according to a prospective research by Zinser et al. [35].
To help reposition the maxilla and mandible precisely in line with the planned surgical strategy, intraoperative surgical navigation has been used. While transverse motions have shown excellent outcomes, vertical variations have shown increasing error. Preoperatively, the navigation must be set up with the least amount of mistake possible utilizing surface markers. Inconsistencies are likely to occur if the systems are not precisely matched. This relatively new method is becoming more popular as a means of achieving the intended outcomes without the need for intraoperative splinting [35].

CONCLUSION

The area of surgical orthodontics is constantly developing and employs both innovative and traditional methods to treat a wide spectrum of malocclusions. It's critical to understand the range of choices accessible to individuals with various pathologies and ages. By doing this, it will be possible to start the right therapies at the right times. Without this knowledge, individuals can need surgery later in life when orthodontics might have prevented it sooner. To get the best outcomes, suppliers must communicate with one another. There are limits to what orthodontics and orthognathic surgery can handle on their own. Both in its pretreatment function of eliminating dental compensations and its posttreatment function of fine-tuning the occlusion, orthodontic treatment is an essential adjunct to orthognathic surgery. New concepts and approaches to treatment are being introduced to the discipline with the emergence of "surgery-first" orthodontics. Additionally, surgical and orthodontic planning is easier and faster as three-dimensional imaging becomes more accessible. Improved patient satisfaction ratings and shorter treatment durations will likely result in improved overall patient care and future results as more information is acquired.

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