One-piece Lefort osteotomy versus segmental procedure for maxillary skeletal deformities - A retrospective study

Kalyani P, Madhulaxmi M*, Santhosh Kumar M P

Department of Oral and Maxillofacial Surgery, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai-600077, Tamil Nadu, India

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Abstract
Maxillary skeletal deformities can occur in all three planes and are corrected by orthognathic surgery. Osteotomies form the basis for orthognathic surgeries. One of the most commonly used osteotomy techniques for maxillary skeletal deformities is the LeFort osteotomy. The aim of this study was to compare the application of One Piece LeFort Osteotomy and Segmental Osteotomy procedures in the treatment of maxillary skeletal deformities. The institutional study involved analysis of case sheets of patients who underwent surgical correction of maxillary skeletal deformities in the stipulated time frame and assessment based on the parameters: Demographic data, type of cephalometric analysis, cephalometric values, type of skeletal deformity, and technique of Osteotomy. Statistical analysis was calculated by chi-square test. A p-value<0.05 was considered significant. Maxillary skeletal deformities were more prevalent among females (60%) than males (40%). Anterior maxillary segmental osteotomies were more commonly performed (60%), followed by LeFort 1 osteotomy (26.7%). The prevalence of posterior osteotomy technique was 13.3%. A statistically significant association was revealed between the type of skeletal malocclusion and technique of Osteotomy used, with a p-value of 0.008<0.05. The type of malocclusion dictates the technique of Osteotomy is used. In a skeletal Class II, segmental malocclusion procedure was more preferred for maxillary deformities.

Introduction
Oral and Maxillofacial Surgeons are involved in the treatment of a wide range of dentofacial deformities. One such deformity is skeletal malocclusion.
ognathic maxilla or mandible or segmental deformities. Of the techniques used for the treatment of maxillary skeletal deformities, the common procedures are LeFort I Osteotomy and segmental techniques, i.e. anterior segmental maxillary Osteotomy and posterior segmental maxillary Osteotomy. LeFort I Osteotomy derives its name from the fracture pattern described by Rene LeFort in 1901. It extends from the piriform aperture, along the tooth apices up to the pterygomaxillary junction. This procedure has a wide range of flexibility as it permits movements in all three planes, making it preferable for any skeletal malocclusion, including transverse maxillary discrepancies and vertical maxillary excess (Hyman and Buchanan, 2013). Segmental LeFort I Osteotomy is a preferred technique for transverse maxillary deficiencies and anterior open bite. (Hyman and Buchanan, 2013)

Some studies have reported the advantages, disadvantages and complications of these procedures. However, a comparative account of these two techniques of osteotomies is extremely low in the case of literature evidence. Till date, the institutional team has conducted several clinical trials - (Jesudasan et al., 2015; Christabel et al., 2016), in-vitro studies- (Marimuthu et al., 2018), and awareness surveys - (Kumar and Rahman, 2017; Packiri, 2017) in the field of Oral and Maxillofacial surgery. Hence, this study was designed in a retrospective epidemiological setup to study the population-based difference in the trends.

The current study aims to evaluate the different indications leading to the selection of a One Piece LeFort I or a Segmental Osteotomy procedure and to compare the influence of the type of malocclusion on procedure selection.

MATERIALS AND METHODS

Study setting

The study was carried out in an institutional setting with the advantage of being a wide range of data available in digital format and the disadvantage of being an assessment of patients in a single location only. Ethical approval was obtained from the Institutional Ethics Committee [SDC/SIHEC/2020/DIASDATA/0619-0320]. The study consisted of one reviewer, one assessor and one guide.

Study design

The study was designed to include all dental patients who had undergone treatment for correction of maxillary skeletal deformities. Syndromic patients, cleft lip and palate patients were excluded from the study.

Sampling technique

The study was based on Non-probability convenience sampling. To minimize the sampling bias, all the case sheets of patients who underwent Osteotomy for maxillary skeletal deformities were reviewed and included.

Data collection and Tabulation

Data collection was done using the patient database with the timeframe work of 1st June 2019 to 30th April 2020. Cross verification of data was done by a reviewer. The collected data were tabulated based on the following parameters:

Patient’s demographic details
Osteotomy Technique
Type of Skeletal deformity
Type of cephalometric analysis
Cephalometric measurements

Statistical analysis

The variables were coded, and the data was imported to SPSS. Using SPSS Version 20.0, categorical variables were expressed in terms of frequency percentage, and bar graphs were plotted. The statistical significance of associations was tested using the Chi-square test.

RESULTS AND DISCUSSION

The correct sample size of the study was n=15. Of these 14 patients had undergone surgery first orthognathic approach. Only one patient had undergone presurgical orthodontics (6.67%).

Table 1 shows the gender-wise distribution of patients undergoing maxillary osteotomy procedures in the stipulated time period, with 60% (n=9) being females and 40% (n=6) being males.

Figure 1: Bar graph depicting the number of osteotomies done in a year for maxillary skeletal deformities.
Table 1: Shows the gender distribution of maxillary osteotomy procedures with a higher prevalence in females than males

|          | Frequency | Percent | Valid Percent | Cumulative Percent |
|----------|-----------|---------|---------------|--------------------|
| Valid    |           |         |               |                    |
| Female   | 9         | 60.0    | 60.0          | 60.0               |
| Male     | 6         | 40.0    | 40.0          | 100.0              |
| Total    | 15        | 100.0   | 100.0         |                    |

Table 2: Showing the age distribution of maxillary osteotomy patients

|        | Mean       | Std. Deviation | Range | Minimum | Maximum |
|--------|------------|----------------|-------|---------|---------|
|        | 26.7333    | 6.60591        | 26.00 | 20.00   | 46.00   |

Table 3: Table depicting the results of Chi-square test between the technique of Osteotomy and type of skeletal malocclusion.

|                          | Value          | df | Asymptotic Significance (2-sided) |
|--------------------------|----------------|----|----------------------------------|
| Pearson Chi-Square       | 13.875a        | 4  | .008                             |
| Likelihood Ratio         | 15.782         | 4  | .003                             |
| N of Valid Cases         | 15             |    |                                  |

a. 8 cells (88.9%) have expected count less than 5. The minimum expected count is .13
p-value 0.008 (<0.05) [statistically significant]

According to Table 2 the mean age of the patients was 26.73 years, with the minimum age being 20 years and maximum age being 46 years.

Figure 1 elaborates the number of cases in each osteotomy technique, the highest being anterior maxillary Osteotomy 60% (n=9) and the least being posterior maxillary osteotomy technique, 13.3% (n=2). About 26.7% (n=4) of patients have undergone one-piece LeFort I Osteotomy.

Figure 2: Bar chart depicting the association between the type of skeletal malocclusion and technique of Osteotomy.

Figure 2 reveals the association between type of skeletal malocclusion and choice of osteotomy technique. Anterior maxillary Osteotomy was the most preferred technique for a skeletal Class II malocclusion, 60% (n=9). Further, the chart findings also reveal that a posterior maxillary osteotomy was done only in patients with skeletal class I malocclusion [13.3%, (n=2)] and the primary indication being an increased posterior maxillary height. One-piece LeFort I Osteotomy being a versatile technique permitting movements in all three planes, was used in any type of skeletal malocclusion with 50% of cases being skeletal class I malocclusion [13.3%, (n=2)].

The association between the type of skeletal malocclusion and technique of Osteotomy was found to be statistically significant with a p-value of 0.008<0.05 after a Chi-square test [Table 3].

Further, a chart was plotted between the technique of Osteotomy and cephalometric analysis [Figure 3], based on which the following inferences have been made:

In cases undergoing AMO [26.7%, (n=4)] and one-piece Lefort I osteotomy [13.3%, (n=2)], Steiner’s was the most preferred cephalometric analysis. Burstone [6.67%, (n=1)] and Ricketts [6.67%, (n=1)] analyses were equally used in cases of AMO. For cases undergoing PMO, Steiner’s [6.67%, (n=1)] or other types [6.67%, (n=1)] of cephalometric analyses were equally used.

Orthognathic surgery consists basically of osteotomy techniques that are performed with an objective of correcting deformities or discrepancies in the endoskeletal system in order to achieve a facial and cranial balance (Sousa and Turrini, 2011; Patil et al., 2017). Lefort, I osteotomy is one of the most common procedures in orthognathic
surgery and is used to correct deformities in all three planes. It is used at times in conjunction with mandibular orthognathic procedures such as Bilateral Sagittal Split Osteotomy (Hyman and Buchanan, 2013; Rao and Kumar, 2018). On the other hand, segmental osteotomies procedures also allow correction to be carried out in all three planes and at the same time provide the flexibility to limit correction to a particular segment of the arch and optimal enhancement of the facial skeleton (Hyman and Buchanan, 2013; Rosen, 1989).

Figure 1, X-axis - Technique of Osteotomy; Y-axis - number of maxillary osteotomies. The highest prevalence was observed for anterior maxillary segmental osteotomy procedure [AMO].

Figure 2, X-axis - Type of skeletal malocclusion; Y-axis - total number of maxillary osteotomies. Anterior maxillary Osteotomy [blue] was the most preferred technique for a skeletal Class II malocclusion. Chi-square test, p-value 0.008 (<0.05); statistically significant.

Figure 3, X-axis - technique of Osteotomy; Y-axis - total number of maxillary osteotomies. For cases undergoing AMO and One-piece Lefort I osteotomy, Steiner’s (yellow) was the most used cephalometric analysis. In cases of PMO, Steiner’s (yellow) and other types (blue) of cephalometric analyses were equally used.

An orthognathic surgery proceeds in the following sequence: Preliminary assessment of patient - Cephalometric radiograph - Cephalometric tracing - Analysis and tabulation - final diagnosis of malocclusion - a selection of osteotomy technique - presurgical orthodontics if required - mock surgery on mounted casts - orthognathic surgery - post-surgical orthodontics (if required) - review and follow up.

A patient undergoing orthognathic surgery is subjected to cephalometric analysis before the surgery to identify and measure certain landmarks that can be altered by surgical procedures (Burstone et al., 1978; Abhinav et al., 2019a) Such a cephalometric analysis enables the operator to assess both hard tissues and soft tissue profiles. The analysis of soft tissue is particularly important in cases of endoskeletal deformities and helps in achieving proper facial aesthetics (Legan and Burstone, 1980; Abhinav et al., 2019b). The values of dental, skeletal and soft tissue components of these cephalometric analyses are not constant and are subject to variances based on the type of malocclusion, and population. According to Jain and Kalra, the cephalometric norms for a North Indian population showed significant variations from the caucasian standards (Jain and Kalra, 2011; Jain et al., 2019).

According to (Janson et al., 2008; Kumar and Sneha, 2016), in a case of skeletal class III malocclusion with temporomandibular pain, a segmental LeFort I Osteotomy procedure gave good results with relief of TMD pain. (Arpornmaeklong et al., 2003; Patturaja and Pradeep, 2016), recommends segmental osteotomy procedures to enhance the occlusal results postoperatively. In another study by (Ho et al., 2010), segmental osteotomies were reported to have comparatively lower complications than other osteotomy procedures. (Hyman and Buchanan, 2013), reported that complications after a One Piece LeFort I Osteotomy occur in about 6.4% of patients, with a higher risk of occurrence in patients with more than 9mm of anterior movement.

(Hernández-Alfar and Guijarro-Martínez, 2016) in his retrospective study of 50 cases of orthognathic surgery observed that in patients with skeletal class III malocclusion LeFort I Osteotomy is the most preferred technique while segmental LeFort I maxillary osteotomy is preferred for cases of the bimaxillary protrusion. Similarly, Xiong Zing Wu quotes subapical anterior maxillary segmental Osteotomy to be an effective treatment option for cases of the maxillary protrusion (Wu et al., 2010). (Arpornmaeklong et al., 2003) has compared the postoperative stability of single piece and segmental maxillary LeFort advancements wherein the segmental osteotomy techniques had better postoperative stability than One piece LeFort I Osteotomy. However, (Hernández-Alfar and Guijarro-Martínez, 2016), contradicts these findings through his study with the inference that reaching the vertical versus horizontal target position is more difficult in a multisegmental LeFort I, but also gives supporting evidence of high stability of multi-segmented osteotomy procedures when compared to one-segment osteotomy technique.

In a systematic review by (Junior et al., 2017) it
has been reported that segmental osteotomy technique provides extremely stable results in the sagittal plane but poor stability in the posterior segment. The review also reveals significant literature evidence which suggests that the procedure cannot be considered as unsafe or unstable and hence can be confidently used in cases requiring movement in all three planes (Junior et al., 2017).

(Moloney et al., 1984), points out the significance of posterior maxillary osteotomy in the closure of posterior edentulous spaces, which was also the exact indications of the patient who underwent posterior maxillary osteotomy in the current study. (Jayaratne et al., 2010), points out the facial soft tissue response of segmental osteotomy technique being good in reducing the labial prominence as well as increasing the nasolabial angle. (Janson et al., 2008), gives evidence of segmental osteotomy procedure being successful in the treatment of skeletal class III malocclusion with TMD, providing adequate pain relief. Though the current study possesses few limitations in the sample size being very small and inability to generalize results to a larger population, the results go well-matched with the existing literature evidence, thus making the overall consensus agreeable.

CONCLUSIONS

There are significant differences between the two techniques of osteotomy, i.e. one piece LeFort I osteotomy and segmental osteotomy, but the type of malocclusion was a major deciding factor, and a segmental procedure has been the most preferred technique for skeletal class II malocclusion in the study population. Future scope of the study allows measurement of postoperative stability and patient satisfaction in a large sample size.

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Authors Contributions

The first author (Kalyani. P) performed the analysis, and interpretation and wrote the manuscript. The second author (Dr Madhulaxmi) contributed to the conception, data design, analysis, interpretation and critically revised the manuscript. The third author (Dr M. P. Santhosh Kumar) participated in the study and revised the manuscript. All three authors have discussed the results and contributed to the final manuscript.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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