

Surgery First (SFA) Approach in Dento-Maxillofacial Alterations: A Narrative Review

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Abstract

The aim of this study was to evaluate, through a systematic review of the literature, the efficacy of Surgery First Approach (SFA) treatment in adult patients with dento-maxillo-facial alterations, observing the advantages over traditional orthodontic-surgical therapy.

This review was carried out according to PRISMA and PICOS approach was used. An electronic and manual search of the Medline (PubMed) databases from 1966 to 2022, Embase from 1980 to 2022 was conducted. The electronic search was performed using the following MeSH terms and text words: [orthognathic surgery AND orthodontics] AND [surgery first approach OR surgery first]. Only studies that included a sample of adult patients (<19 years and >65 years of age) with Class II and III malocclusion, skeletal open bite, OSAS and facial asymmetries were selected.

From a total of 847 articles identified, only 16 met the inclusion criteria: 2 Randomized Clinical Trials, 1 prospective non-randomized study, 2 prospective court studies, 3 prospective studies, 3 retrospective court studies, 1 retrospective case-control study, 4 retrospective studies.

All 16 studies are in favor of the surgery-first approach for several reasons including: the reduction of total treatment times, an immediate improvement in the aesthetic perception and social aspect in the life of patients, an overlapping skeletal and occlusal stability to the standard approach.

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Introduction

The surgery first approach (SFA) can be defined as a surgery without orthodontic preparation, in which orthodontic treatment is performed after surgery.^{1,2} The patient benefits from a shorter period of orthodontics and the facial discrepancy period is eliminated. Furthermore, there is the absence of the aggravation of the appearance during the orthodontic pre-surgical period. This consideration results in a high patient satisfaction rate from the early stages of treatment and better cooperation during postoperative orthodontics.

The criteria necessary for the application of SFA includes the following: front teeth well aligned or slightly crowded, a flat to mild curve of Spee, normal to mild proclination or retroclination

of the incisors and minimal transverse discrepancy.¹

However there are possible contraindications and disadvantages to SFA.² The contraindications are severe anterior superior crowding with consequent occlusal interference, upper incisors flared strongly compensated with difficulties of aesthetic satisfaction immediately after surgery due to excessive overjet, excessively extruded upper second molars with excessive interference in posterior surgical occlusion which can compromise postoperative stability, disharmony of the upper and lower intercanine width with consequent postoperative interference and bone instability, asymmetric transverse dental compensation in facial asymmetry. The possible disadvantages of the SFA are as follows: more complex surgical procedures, the need for an accurate and expert decision-making process about the possibility of SFA, a longer period of intermaxillary bone fixation, difficulty of chewing immediately after surgery due to the presence of an incomplete occlusion, incomplete facial profile immediately after surgery.^{1,2}

With respect to these disadvantages, it is

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good to consider that individuals with dentoskeletal deformities often suffer from altered oral function and disharmonious facial profile, which can determine a lower quality of life (QoL). Orthognathic surgery using a surgical-first approach (SFA) would also appear to provide a better QoL for the duration of treatment.³ Treatment with SFA improves Oral Health Related QoL (OHRQoL) in patients with dentofacial deformities compared to conventional pre-surgical orthodontic treatment, immediately after surgery and this trend continues throughout the course of treatment, without pre-surgical deterioration.⁴

Surely a great benefit for the SFA can be given by virtual surgery and machine learning based approach. Over the years, "virtual surgery" planning approaches have been proposed to replace conventional physical model-based planning, allowing the surgeon to conduct multiple simulations without requiring surgical templates.⁵ Recently, a machine learning based approach has been introduced to predict postoperative skeletal changes. Specifically selected reference points are used for surgical planning. The results showed great potential in reducing the work of surgeons, thanks to machine learning, since it is possible to predict postoperative skeletal changes in necessary for orthognathic surgical planning.⁵

The aim of this study was to evaluate, through a systematic review of the literature, the efficacy of Surgery First Approach (SFA) treatment in adult patients with dento-maxillofacial alterations, observing the advantages over traditional orthodontic-surgical therapy.

Materials and methods

This review was carried out according to the Cochrane Handbook for Systematic Reviews of Interventions and Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).⁶ The literature search and study inclusion were carried out in duplicate by two review authors (R.G. and F.D.A.) Any discrepancy was discussed with a third reviewer (E.B.) for consensus.

PICOS approach

Dento-maxillofacial changes can have a negative impact on the quality of life of patients. The following criteria through PICOS were selected in this study:

- Population (P): Adult patients with non-growing, non-syndromic maxillofacial skeletal deformity.
- Intervention (I): Correction of dental and skeletal anomalies (non-syndromic) with traditional orthodontic-surgical protocol.
- Comparison (C): Surgery First approach.
- Outcome (O): Reduction of treatment time, patient satisfaction and treatment stability.
- Study Design (S): Randomised Clinical Trials, Controlled Clinical Trials, Prospective or Retrospective Cohort Studies, Observational Studies, Cross Sectional Studies, Case-Control Studies.

Research Strategy

Detailed search strategies were developed to identify studies that could be included in this systematic review

Electronic Search

An electronic search of the Medline (PubMed) databases from 1966 to 2022, Embase from 1980 to 2022 was conducted. The search strategy used combinations of keywords and was linked to the Cochrane Highly Sensitive Search Strategy (CHSSS) for the identification of Randomized Clinical Trials in MEDLINE: maximizing sensitivity version (2008 revision) as stated in chapter 6.4.11.1 and detailed in box 6.4.c of the Cochrane Handbook for Systematic Reviews of Interventions version 5.1.0.98. The electronic search was performed using the following MeSH terms and text words: [orthognathic surgery AND orthodontics] AND [surgery first approach OR surgery first].

Manual Search

A manual search limited to articles published between January 2010 and July 2022 was conducted in the following peer-reviewed journals: American Journal of Orthodontics and Dentofacial Orthopedics, Oral and Maxillofacial Surgery, Journal of Oral and Maxillofacial Surgery, Journal of Craniofacial Surgery, Orthodontics and Craniofacial Research, Journal of Orthodontics, European Journal of Orthodontics.

Eligibility Criteria

On this basis, only studies that included a sample of adult patients (<19 years and >65 years of age) with Class II and III malocclusion, skeletal open bite, OSAS and facial asymmetries were selected.

Inclusion Criteria were:

- Randomized controlled clinical trials
- Cohort studies

- Case-control studies
- Observational studies
- Cross-sectional studies

Only studies written in English were considered.

Study Exclusion Criteria

Studies that examined a sample of patients with systemic diseases, syndromic patients, TMD patients and post-traumatic patients were excluded.

- Case report studies
- Case series studies
- Systematic reviews or meta-analyses

Selection Of Studies

Based on the inclusion criteria, titles and abstracts of publications were screened independently by two experienced authors. Full-text versions were obtained for titles and abstracts that appeared to meet the inclusion criteria or that reported insufficient data to make a clear decision. Full-text analysis was performed independently. Any disagreements during the selection process were resolved through discussion and when they could not be resolved a third author was consulted. Cohen's kappa coefficient (k) was used to calculate the agreement between the reviewers. The level of agreement is considered excellent when k is > 0.75, fair to good when it is 0.40 to 0.75, and poor when it is < 0.40. All articles meeting the inclusion criteria underwent data extraction and quality assessment. All irrelevant articles were excluded and the reasons for their exclusion were outlined.

Qualitative Assessment Of Studies

This assessment was conducted using the Cochrane-recommended approach for assessing the risk of bias in randomised controlled trials including four quality parameters: sequence generation, address of incomplete outcome data, lack of selective outcome reporting and other sources of bias.⁷

Results

Study selection

The flowchart of the search strategy is shown in Figure 1. A total of 847 articles were identified, 830 through the electronic search system and 17 from the manual search. Of the

750 studies resulting after removal of duplicates, 400 were excluded based on title evaluation (inter-reader agreement $k = 0.81 \pm 0.33$) and 300 based on reading the abstracts (inter-reader agreement $k = 0.71 \pm 0.22$). Finally, of the 50 articles remaining for full-text evaluation, 16 met the inclusion criteria and 34 were excluded. The year of publication of the included studies ranged from 2013 to 2020. The 16 articles included in this systematic review are schematically shown in Table.⁸⁻²³

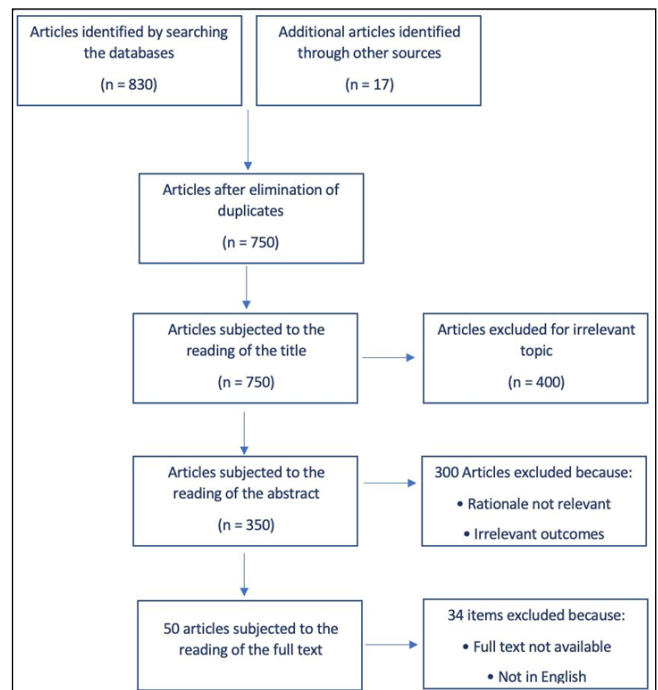


Figure 1. Flowchart of the search strategy.

| Authors | Year | Geographical Origin | Type Of Study |
|--------------------------|------|---------------------|----------------------------------|
| Hu J et al | 2020 | China | Retrospective court study |
| Liao YF et al | 2020 | Taiwan | Retrospective case-control study |
| Jeong WS et al | 2018 | Korea | Retrospective study |
| Feu D et al | 2017 | Brazil | Prospective non-randomized study |
| Pelo S et al | 2017 | Italy | Randomized Clinical Trial |
| Jeong WS et al | 2017 | Korea | Retrospective study |
| Zingler S et al | 2017 | Germany | Prospective court study |
| Wang J et al | 2017 | China | Prospective court study |
| Jeong WS et al | 2017 | Korea | Prospective study |
| Huang S et al | 2016 | China | Prospective longitudinal study |
| Park KH et al | 2016 | South Korea | Retrospective study |
| Choi JW et al | 2015 | Korea | Clinical Trial |
| Yu HB et al | 2015 | China | Retrospective court study |
| Min BK et al | 2014 | South Korea | Retrospective study |
| Hernández-Alfaro F et al | 2014 | Spain | Prospective study |
| Ko EW et al | 2013 | Taiwan | Studio di coorte retrospectivo |

Table 1. Articles selected for review.

Characteristics of the study

The studies comparing the SFA protocol with the traditional protocol included in this systematic review were:

- 2 Randomized Clinical Trials
- 1 prospective non-randomized study
- 2 prospective court studies

- 3 prospective studies
- 3 retrospective court studies
- 1 retrospective case-control study
- 4 retrospective studies.

Out of 16 studies, 6 compared the quality of life in relation to the oral health of patients treated with the surgery-first protocol and those treated with the traditional protocol, 2 studies compared the two protocols in relation to the treatment time, 4 studies evaluated skeletal stability with a follow up from 6 to 24 months post-surgery, other 2 studies evaluated two different types of pre-surgical planning, finally 2 studies evaluated the benefits and limitations of the first surgical approach.

All 16 studies are in favor of the surgery-first approach for several reasons including: the reduction of total treatment times, an immediate improvement in the aesthetic perception and social aspect in the life of patients, an overlapping skeletal and occlusal stability to the standard approach.

In 2 studies the limits of the surgery-first approach are also highlighted since it is a protocol that requires a precise diagnosis, careful planning and constant communication between surgeon and orthodontist, figure that in cases of orthognathic surgery it is essential that it is qualified.

Discussion

Today, orthodontics is increasingly aimed at adult patients as an integral part of a multidisciplinary treatment that involves other medical and dental specialties. Orthodontic-orthognathic surgical treatment is now considered not only a path towards correct function, but also a path towards improving the patient's aesthetic appearance. Since the concept of health, today, has extended from the strictly physical to that of general well-being, the patient not only asks to resolve the disease, but asks to "feel good", with himself and with others. Consequently, in addition to achieving good health, the patient has aesthetic expectations and increasingly expresses the need for reduced treatment times. The surgery-first approach represents one of the recent trends of greatest interest for the management of dento-maxillary deformity. After the first clinical description, most subsequent publications have been case reports

documenting the potential value of the approach.²⁴ Conceptually, the method foresees, as the name suggests, to proceed directly with the surgery, in order to bring the bone bases in the desired position. At this point, the dental arches will find themselves in a strongly decompensated state, to be resolved with an orthodontic therapy, potentially even short. This procedure has an important effect on patient compliance with postoperative orthodontics and contributes greatly to overall treatment satisfaction.⁸

In 2016, Peiró-Guijarro and colleagues published a first general systematic review on the surgery first approach.²⁵ In addition to timing, the authors underline an important advantage linked to aesthetics: the facial profile is improved from the first therapeutic act, namely the correction of the skeletal base. Esthetic changes produced from orthodontic therapy and surgical orthodontic therapy are increasingly considered in terms of the final result.²⁶ This aspect involves a high degree of satisfaction for the patient, with a reduction in the psychological impact associated with decompensation therapy and can be more cooperative in the course of post-surgical orthodontic treatment.

In 2019, Huang and colleagues published a systematic review, aimed at investigating the psychological aspect, i.e. the impact on the oral health-related quality of life.²⁷ This means that the study considered some quantifiable parameters, establishing how effectively, from the patient's point of view, proceeding immediately to surgery solves various psychosocial problems. These data are particularly important if we consider that orthodontic-surgical patients are the most focused to the aesthetic considerations of the profile.²⁸

Furthermore, in other clinical situations, such as for example those concerning obstructive apneas, the advancement of the maxillo-mandibular complex immediately produces an increase in the volume of the upper airways.²⁹ Furthermore, the greater efficiency of the orthodontic movement related to the "Surgery-First" treatment was related to the RAP (Regional Acceleratory Phenomenon) and to the more favorable soft tissue tone expressed following the surgery.³⁰ The latter can lead to a synergistic effect between the application of orthodontic force and the new adaptive force

exerted by the lip and tongue in the direction of the tooth movement during the post-surgical phase. The transient decrease in muscle activity and the consequent reduction in occlusal pressure present in the first weeks following the surgical phase could also be considered as additional adjuvant factors. As regards relapse, it also emerges that on the overlap of cephalometric changes in patients with and without pre-surgical orthodontic treatment, the relapse rate is not different between the two different approaches.¹⁹ In this regard, in the literature there are in particular three studies that have described the stability of the maxillomandibular complex at least one year after surgery. Wang et al., Liao et al. and Ko et al. investigated the stability of surgical outcomes in patients with class III dysgnathia in the transverse, vertical and sagittal planes, respectively.³¹⁻³³ The only statistically significant difference between the two protocols is the greater tendency to upward mandibular movement in cases treated with the "Surgery-First" approach, which has proved to be useful in avoiding recurrence of the anterior open bite. Baek et al, Choi et al and Yang et al also did not find statistically significant differences in stability between Surgical first approach and Traditional Orthognathic Surgery.³⁴⁻³⁶ For transversal discrepancy, Wang et al reported that the final treatment outcome in both Surgical first approach and Traditional Orthognathic Surgery was similar.³¹ On the vertical plane, Liao et al reported an increase in counterclockwise rotation, while Kim et al found a clockwise rotation of the mandible in the Surgical first approach group compared to the Traditional Orthognathic Surgery group.^{32,37} For the sagittal plane, Kim and al found approximately 2.4 mm greater relapse in Surgical first approach compared to 1.6mm in Traditional Orthognathic Surgery.³⁸

Surely future research must be directed to the need to find a consensus regarding the surgical protocols and the selection criteria for the patients to undergo the surgery first procedure. In any type of orthognathic surgery it is however necessary to consider possible post-surgical complications that could compromise the result and prolong the postsurgery orthodontic treatment time.³⁹

Conclusions

This systematic review highlighted the lack of randomized trials on this approach. The heterogeneity and level of evidence of the retrieved publications, combined with the wide variety of outcome variables, prevented a meta-analysis. Several scientific articles, despite their exclusion from this systematic review, have provided relevant preliminary results and technical guidelines that have nevertheless allowed subsequent studies.

The "Surgery-First" protocol offers an alternative to the traditional method for the correction of dento-skeletal dysmorphism. The final results in terms of facial aesthetics, occlusion and stability are comparable to those of the classic protocol, with the important advantage of obtaining an improvement in aesthetics immediately at the end of the surgical phase.

The accelerated tooth movement is one of the characteristics of the post-operative orthodontic treatment that allows to significantly reduce the duration of the final phase of therapy. However, it is essential that the orthodontist is experienced in the management of orthodontic-surgical cases and that collaboration with the maxillofacial surgeon can be guaranteed at the highest levels in every phase of the treatment.

The careful selection of patients, precise programming and constant feedback among the clinicians involved in the treatment represent the key to success in the application of this protocol, which allows to obtain a significant reduction in therapeutic times, a substantial improvement in patient satisfaction, with consequent high levels of satisfaction also on the part of the orthodontist.

Declaration of Interest

The authors report no conflict of interest.

References

1. Ahmadvand A, Alavi S, Mehraban SH. An overview of surgery-first orthognathic approach: History, indications and limitations, protocols, and dentoskeletal stability. *Dent Res J (Isfahan)*. 2021 Jun 22;18:47.
2. Choi JW, Lee JY. Current concept of the surgery-first orthognathic approach. *Arch Plast Surg*. 2021 Mar;48(2):199-207.
3. Vongkamolchoon S, Sinha SP, Liao YF, Chen YR, Huang CS. The impact of a surgery- first approach on oral health-related quality of life. *Int J Oral Maxillofac Surg*. 2021 Oct;50(10):1336-1341.
4. Feitosa MCP, Garib D, de Cássia Moura Carvalho Lauris R, Herkrath APQ, Vettore MV. The impact of orthognathic surgery on quality of life in individuals with oral clefts. *Eur J Orthod*. 2022 Mar 30;44(2):170-177
5. Ma Q, Kobayashi E, Fan B, Hara K, Nakagawa K, Masamune K, Sakuma I, Suenaga H. Machine-learning-based approach for predicting postoperative skeletal changes for orthognathic surgical planning. *Int J Med Robot*. 2022 Jun;18(3):e2379.

6. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Int J Surg*. 2010;8(5):336-41.
7. Higgins JPT, Green S. *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0 [updated March 2011]. The Cochrane Collaboration; 2011. Available from www.cochrane-handbook.org
8. Hu J, Jiang Y, Wang D, Guo S, Li S, Jiang H, Cheng J. Comparison of cost-effectiveness and benefits of surgery-first versus orthodontics-first orthognathic correction of skeletal class III malocclusion. *Int J Oral Maxillofac Surg*. 2020 Jul 15:S0901-5027(20)30215-0.
9. Liao YF, Chen YA, Chen YC, Chen YR. Outcomes of conventional versus virtual surgical planning of orthognathic surgery using surgery-first approach for class III asymmetry. *Clin Oral Investig*. 2020 Apr;24(4):1509-1516.
10. Jeong WS, Lee JY, Choi JW. Large-Scale Study of Long-Term Vertical Skeletal Stability in a Surgery-First Orthognathic Approach Without Presurgical Orthodontic Treatment: Part II. *J Craniofac Surg*. 2018 Jun;29(4):953-958.
11. Feu D, de Oliveira BH, Palomares NB, Celeste RK, Miguel JAM. Oral health-related quality of life changes in patients with severe Class III malocclusion treated with the 2-jaw surgery-first approach. *Am J Orthod Dentofacial Orthop*. 2017 Jun;151(6):1048-1057.
12. Pelo S, Gasparini G, Garagiola U, Cordaro M, Di Nardo F, Staderini E, Patini R, de Angelis P, D'Amato G, Saponaro G, Moro A. Surgery-first orthognathic approach vs traditional orthognathic approach: Oral health-related quality of life assessed with 2 questionnaires. *Am J Orthod Dentofacial Orthop*. 2017 Aug;152(2):250-254.
13. Jeong WS, Lee JY, Choi JW. Large-Scale Study of Long-Term Anteroposterior Stability in a Surgery-First Orthognathic Approach Without Presurgical Orthodontic Treatment. *J Craniofac Surg*. 2017 Nov;28(8):2016-2020.
14. Zingler S, Hakim E, Finke D, Brunner M, Saure D, Hoffmann J, Lux CJ, Erber R, Seeberger R. Surgery-first approach in orthognathic surgery: Psychological and biological aspects - A prospective cohort study. *J Craniomaxillofac Surg*. 2017 Aug;45(8):1293-1301.
15. Wang J, Chen W, Ni Z, Zheng M, Liang X, Zheng Y, Zhou Y. Timing of orthognathic surgery on the changes of oral health-related quality of life in Chinese orthognathic surgery patients. *Am J Orthod Dentofacial Orthop*. 2017 Mar;151(3):565-571
16. Jeong WS, Choi JW, Kim DY, Lee JY, Kwon SM. Can a surgery-first orthognathic approach reduce the total treatment time? *Int J Oral Maxillofac Surg*. 2017 Apr;46(4):473-482. doi: 10.1016/j.ijom.2016.12.006. Epub 2016 Dec 30. Erratum in: *Int J Oral Maxillofac Surg*. 2017 Sep;46(9):1203.
17. Huang S, Chen W, Ni Z, Zhou Y. The changes of oral health-related quality of life and satisfaction after surgery-first orthognathic approach: a longitudinal prospective study. *Head Face Med*. 2016 Jan 5;12:2.
18. Park KH, Sandor GK, Kim YD. Skeletal stability of surgery-first bimaxillary orthognathic surgery for skeletal class III malocclusion, using standardized criteria. *Int J Oral Maxillofac Surg*. 2016 Jan;45(1):35-40.
19. Choi JW, Lee JY, Yang SJ, Koh, KS: The reliability of a Surgery-First orthognathic approach without presurgical orthodontic treatment for skeletal class III dentofacial deformity. *Ann Plast Surg*. 2015; 74:333-41.
20. Yu HB, Mao LX, Wang XD, Fang B, Shen SG. The surgery-first approach in orthognathic surgery: a retrospective study of 50 cases. *Int J Oral Maxillofac Surg*. 2015 Dec;44(12):1463-7.
21. Min BK, Choi JY, Baek SH. Comparison of treatment duration between conventional three-stage method and surgery-first approach in patients with skeletal Class III malocclusion. *J Craniofac Surg*. 2014 Sep;25(5):1752-6.
22. Hernandez-Alfaro F, Gujjarro-Martinez R, Peirò-Gujjarro MA: Surgery first in orthognathic surgery: what have we learned? A comprehensive workflow base on 45 consecutive cases. *J Oral Maxillofac Surg*. 2014; 72:376-90.
23. Ko EW, Lin SC, Chen YR, Huang CS. Skeletal and dental variables related to the stability of orthognathic surgery in skeletal Class III malocclusion with a surgery-first approach. *J Oral Maxillofac Surg*. 2013 May;71(5):e215-23.
24. Nagasaka H, Sugawara J, Kawamura H, Nanda R. "Surgery first" skeletal Class III correction using the Skeletal Anchorage System. *J Clin Orthod* 2009;43:97-105
25. Peirò-Gujjarro MA, Gujjarro-Martínez R, Hernández-Alfaro F. Surgery first in orthognathic surgery: A systematic review of the literature. *Am J Orthod Dentofacial Orthop*. 2016 Apr;149(4):448-62
26. Galluccio G, Guarnieri R, Jamshir D, Impellizzeri A, Ierardo G, Barbato E. Comparative Evaluation of Esthetic and Structural Aspects in Class II Functional Therapy. A Case-Control Retrospective Study. *Int J Environ Res Public Health*. 2021 Jun 29;18(13):6978.
27. Huang X, Cen X, Sun W, Xia K, Yu L, Liu J, Zhao Z. The impact of surgery-first approach on the oral health-related quality of life: a systematic review and meta-analysis. *BMC Oral Health*. 2019 Jul 8;19(1):136
28. Cassetta M, Guarnieri R, Mezio M, Altieri F, Brandetti G, Padalino G, Di Giorgio R, Barbato E. Comparison of profile macro-esthetic perception among orthodontists, dentistry students, orthodontic patients and surgical orthodontic patients. *J Clin Exp Dent*. 2020 Dec 1;12(12):e1109-e1116
29. Aristizábal JF, Martínez-Smit R "Surgery first" approach as an alternative for maxillomandibular advancement in patients with obstructive sleep apnea. *J Clin Orthod*. 2021 Oct;55(10):607-616.
30. Chen YW, Wang HC, Gao LH, Liu C, Jiang YX, Qu H, et al. Osteoclastogenesis in Local Alveolar Bone in Early Decortication-Facilitated Orthodontic Tooth Movement. *PLoS one*. 2016; 11(4):e0153937
31. Wang YC, Ko EWC, Huang CS, Chen YR, Takano-Yamamoto T: Comparison of transverse dimensional changes in surgical skeletal Class III patients with and without presurgical orthodontics. *J Oral Maxillofac Surg*. 2010 Aug; 68(8):1807-12
32. Liao YF, Chiu YT, Huang CS, Ko EWS, Chen YR: Presurgical orthodontics versus no presurgical orthodontics: Treatment outcome of surgical-orthodontic correction for skeletal Class III open bite. *Plast. Reconstr. Surg*. 2010 Dec;126(6): 2074-83.)
33. Ko EW, Hsu SS, Hsieh HY, Wang YC, Huang CS, Chen YR: Comparison of progressive cephalometric changes and postsurgical stability of skeletal Class III correction with and without presurgical orthodontic treatment. *J Oral Maxillofac Surg*. 2011; 69:1469-77.
34. Baek SH, Ahn HW, Kwon YH, Choi JY. Surgery-first approach in skeletal class III malocclusion treated with 2-jaw surgery: evaluation of surgical movement and postoperative orthodontic treatment. *J Craniofac Surg*. 2010 Mar;21(2):332-8.
35. Choi JW, Lee JY, Yang SJ, Koh KS. The reliability of a surgery-first orthognathic approach without presurgical orthodontic treatment for skeletal class III dentofacial deformity. *J Craniofac Surg*. 2010;21:332-8.)
36. Yang L, Xiao YD, Liang YJ, Wang X, Li JY, Liao GQ. Does the surgery-first approach produce better outcomes in orthognathic surgery? A systematic review and meta-analysis. *J Oral Maxillofac Surg*. 2017 Nov;75(11):2422-9.
37. Kim JY, Jung HD, Kim SY, Park HS, Jung YS. Postoperative stability for surgery-first approach using intraoral vertical ramus osteotomy: 12 months follow-up. *Br J Oral Maxillofac Surg*. 2014 July;52(6):539-44.
38. Kim CS, Lee SC, Kyung HM, Park HS, Kwon TG. Stability of mandibular setback surgery with and without presurgical orthodontics. *J Oral Maxillofac Surg*. 2014; 72(4):779-87.
39. Agustine C, Purbiati M. Orthodontic treatment after unintended unilateral fixation plate removal following single-jaw orthognathic surgery. *Journal of International Dental and Medical Research*. 2018; 11(2): 454 – 458