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Case Report Open Access

# "Surgery First" and Low Level Laser Therapy to Reduce Treatment Time in Ortho-Surgical Procedures

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## Abstract

**Aim:** To show how the integration of two highly efficient developed techniques used to reduced orthodontic treatment time in a case that required orthognathic surgery to correct a class III Dento-Maxillo-Facial anomaly.

**Methods:** A 21 years old class-III male patient, with prognathism, macrognathism and mandibular levognathism treated with the following treatment plan: surgical- orthodontic treatment with no extractions, using fixed standard prescription brackets with slot 0.022 × 0.028 inches, Surgery first for mandibular set-back and para-nasal grafts. Low Level Laser extra oral irradiation after surgery and intra oral up to the end of the orthodontic active phase. Retention with Esssix superior and inferior splints.

**Results:** The class-III anomaly was treated in ten months using the "Surgery First" approach and low intensity laser therapy to potentiate the effect in the overall treatment.

**Conclusion:** A class-III Dento-Maxillo-facial anomaly was corrected in a patient during a full treatment time of 10 months, combining the "Surgery First" approached with low level laser therapy to potentiate the effect that both techniques provide to accelerate the rate of tooth movement.

**Keywords:** Orthodontics; Orthognathic surgery; Low level laser therapy; Dental movement acceleration; Surgery first

## Introduction

One of the main inconveniences for patient and clinician in orthodontic corrective treatments is the long time span demanded. This is considerably increased when the patient presents a Dento-Maxillo-Facial Anomaly requiring orthognathic surgery as part of the treatment, this surgery conventionally performed following a previous orthodontic preparation [1-4]. The combined treatment typically takes two-three years [5,6]. Nagasaka et al. [7] suggested performing the surgical treatment without orthodontic preparation, doing the dental alignment after surgery. This approach known as "Surgery First" significantly reduces the time of treatment for malocclusions with skeletal involvement [8-14]. Additionally, Low Level Laser Therapy (LLLT) has proved to be a non-cytotoxic [15,16] and effective technique to stimulate osteoblast [17-21] and osteoclast proliferation, and therefore stimulates new bone formation, which is essential to accelerate orthodontic dental movement, as it's evidenced by studies in animal models [22-24].

Previous studies provide evidence that LLLT is a safe and efficient alternative, not only to reduce orthodontic treatment span [25-29] but to significantly reduce pain symptoms associated to corrective orthodontics as well [30-34]. The protocol here described showed to be effective applying the laser therapy once a month during the orthodonctic tretament to promote dental movement acceleration.

The purpose of this case report is to show how the integration of two highly efficient developed techniques are used to reduced orthodontic treatment time in a case that required orthognathic surgery to correct a class III Dento-Maxillo-facial anomaly.

## Case Report

The patient was a 21 year old man referred for treatment "to provide maxillary stabilization previous to surgery" to the Orthodontics clinic of the Universidad del Valle, Cali, Colombia.

The clinical facial examination revealed asymmetry among facial thirds with the inferior third higher than the medium third and the medium third higher than the superior one; mandibular left-deviation, optic plane left-canted, parallel bi- commissure plane, asymmetric facial fifths due to higher size of the external fifths, inner eye cant not coincident with nasal wings; right iris inner ridge not coincident with right lip commissure. While smiling the patient presented asymmetry due to more left side dental exposition and tooth exposure higher than 90% versus inferior to 40%. While smiling it was more evident the mandibular deviation, with more face left-side contraction (Figure 1).

The intraoral examination revealed a right molar class III

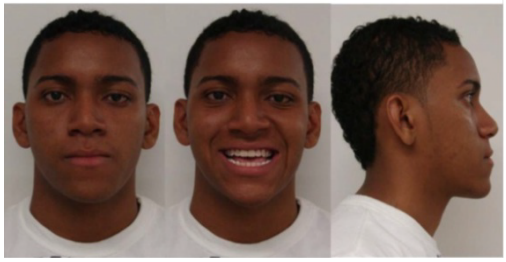

**Figure 1:** Pretreatment extra oral photographs.

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**Figure 2:** Pretreatment intra oral photographs.

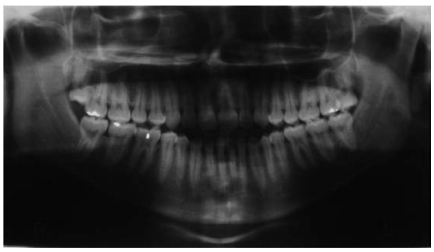

**Figure 3:** Pretreatment Panorex.

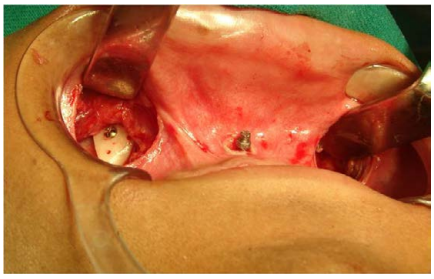

**Figure 4:** Mandibular sagittal cut.

relationship of 11 mm, right canine class III (9 mm), left molar class III (7 mm) and left canine class III (5 mm). Additionally it was observed a non-coincidence of the midlines, being the Inferior midline deviated by 3mm to the left. Over jet: -8 mm and over bite -1 mm (Figure 2)

The panoramic X-ray film indicated long and rounded condyles, long mandibular rama with the left one slightly larger, thin and asymmetric mandibular bodies, being the right one thinner and longer than the left one; maxillary cortical sinus well defined with no evidence of air-way obstructions. The patient presented permanent dentition with 31 teeth present, 18 non-erupted, and crown-root ratio 1:2 (Figure 3).

The cephalometric analysis indicated that the posterior and anterior cranial base was increased, lightly anteriorly tipped, mild superior prognathism, severe inferior prognathism and macrognathism, severe class III inter maxillary sagittal relation, meso facial pattern, pro-inclined superior incisive and severe protrusion, inferior incisive with severe protrusion and mild pro-inclination; acute interincisal angle, negative overjet, reduced overbite; middle and inferior third augmented, mandibular ramus size increased, mandibular size increased, high goniac angle.

The soft- tissue measurements indicated: acute nasolabial angle, biprochelia, superior lip length increased, concave profile, class III angle of soft-tissues (Table 1).

According to the clinical and cephalometric data the patient was diagnosed as class III with prognathism, macrognathism and mandibular levognathism. After interdisciplinary staff discussion of the case, it was decided the following treatment plan: a Previous periodontal examination and prophylaxis, surgical-orthodontic treatment with no extractions, using fixed standard prescription brackets with slot 0.022 × 0.028. Orthognathic Surgery first for mandibular set-back and paranasal grafts. Low Level Laser extra oral irradiation after surgery and intraoral up to the end of the orthodontic active phase. Retention with Esssix superior and inferior splints.

## Treatment sequence

After a Previous periodontal examination and prophylaxis, the standard brackets was bonded in both superior and inferior dental arches one week before the orthognathic surgery.

## Surgery first procedure

Under general anesthesia a 10 mm mandibular setback was performed using sagittal bilateral cuts and clockwise rotation to center menton correcting the mild mandibular levognathism. Additionally, autologous paranasal grafts were applied, using as a graft donor site the mandibular ramus, to improve the maxillary hypoplasia. (Figures 4 and 5)

Immediately after surgery Cu-Ni-Ti 0.016 arches were placed in both dental arches and 4.5 ounce class III elastics therapy implemented.

## Laser protocol during the active orthodontic treatment

The patient was monitored every 15 days but received laser therapy only during the monthly control visits. During each monthly visit he was irradiated with the equipment Photon Lase II (GaAlAs laser) (DMC Equipamentos, Sao Carlos, Brazil) using 830 nm wavelength, 100 mW, 80 J/cm$^2$, energy per point 2,2 J, for 22 seconds, along the vestibular surface and 22 seconds along the palatal surface for each tooth root, at a distance of 1 mm away of the mucosa in each arch. After surgery, the patient was irradiated for edema and inflammation control, beginning two days after the procedure. Laser was applied performing scanner movements along the extra oral surface, 3 times per side, a total of six sessions in two weeks. The equipment was used with the following parameters: 830 nm wavelengths, 100 mW, 70 J/cm$^2$, for 19 seconds each spot.

## Active orthodontic treatment sequence

The first clinical control two days after surgery indicated that the patient had full open Bite, occluding only teeth 17, 47; 27 and 37. Over the Cu-Ni-Ti wire arches were placed 5/16 zig-zag elastics, initiating at the superior second molars and finishing in the inferior canine teeth to provide a class III vector to close the bite from distal to mesial and keep the mandible in position. Two months later, the same elastics

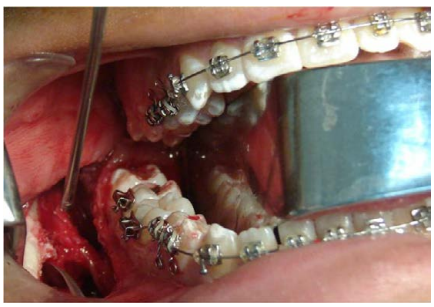

**Figure 5:** Autologous paranasal graft procedure.

**Figure 6:** Post treatment extra oral photographs.

| Measurements | Norma | Pre-treatment | Post-treatment |
|---|---|---|---|
| S-N-A ( ) | 82 | 80 | 81 |
| Fh/N-A ( ) | 80 | 94 | 93 |
| A/Fh-N | 0 | 5 mm | 4 mm |
| S-N-B ( ) | 80 | 87 | 85 |
| Fh/N-Pg ( ) | 87 | 100 | 97 |
| Pg - Fh/N (mm) | 0-2 | +23 mm | 16 mm |
| Go-Gn (mm) | 71 | 92 mm | 90 mm |
| Xi-Pm (mm) | 65 | 93 mm | 90 mm |
| ANB( ) | 2 | 7 | 4 |
| Wits (mm) | 0 | -16 mm | 8 |
| Facial axis( ) | 140 | 93 | 94 |
| Gonial angle ( ) | 142 | 124 | 129 |
| Maxillary-mandibular plane ( ) | 145 | 23 | 29 |
| Mandibular plane ( ) | 26 | 19 | 27 |
| Lower face height ( ) | 47 | 46 | 43 |
| Total maxillary lenght | 98 mm | 98 mm | 99 mm |
| Total mandibular lenght | 128-131 | 148 mm | 141 mm |
| Lower face height (mm) | 68-70 | 79 mm | 77 mm |
| 1-Bsp | 110 | 125 | 126 |
| 1/A-Pg | 3.5 | 2 mm | 4 mm |
| 1/N-A | 22 | 35 | 37 |
| 1-Fh/N | 4-6 mm | 14 mm | 14 |
| 1/Go-Gn | 90 | 95 | 75 |
| 1-Fh/N | 1-3 mm | 22 mm | 12 mm |
| 1/A-Pg | 1 mm | 8 mm | 3 mm |
| 1/A-Pg | 130 | 41 | 23 |
| 1 U / 1 L | 2.5 mm | 117 | 129 |
| Overjet | 2.5 mm | 8 mm | 0.5 mm |
| Overbite | 2.5 mm | 1 mm | 2.0 mm |
| Upper Lip-Sn-Pg | 3.5 mm | 6 mm | 5.5 mm |
| Lower Lip- Sn-Pg | 2.2 mm | 7 mm | 4 mm |
| Lower Lip -E | (-)1 mm | 1 mm | -1 mm |
| Nasolabial angle | 102 | 65 | 88 |
| Upper Lip lenght | 24.5 mm | 28 mm | 27 mm |

**Table 1:** Cephalometric pre-treatment and post-treatment measurements.

were placed with stainless steel 0.016 and 0.018 arch-wires with vertical component. The finishing and adjustment phase was made with 0.019 × .25 wire with ideal bending's and class III elastics.

The total time of active treatment was 10 months. The retention was obtained with superior and inferior Essix splints. The period of retention was 6 months full time use, 6 months only in the night and after of that, one day per week permanently.

## Post-treatment changes

**Facial changes:** Facial symmetry was achieved, Menton deviation was corrected, good exposition of superior incisive during smiling was obtained and the inferior third height was reduced (Figure 6).

**Skeletal changes:** Prognathism and mandibular macrognathism were reduced (Table 1 and Figure 7).

**Dental changes:** Anterior cross-bite was corrected; the patient finished with bilateral canine class I, left molar class I, anterior coupling, coincident midlines, correct alignment and leveling (Figure 8) and root parallelism (Figure 9).

**Undesired effects:** Inferior incisive retro-inclination, class III right molar. After one year post treatment, the patient shows good stability (Figures 10 and 11).

## Discussion

In the case reported the combined orthodontic-surgical treatment of a class III Dento-Maxillo-Facial Anomaly involved the use of standard technique combined with "first surgery" and LLLT was completed in 10 months, although in the first post- surgical control it was found full open bite as a complication.

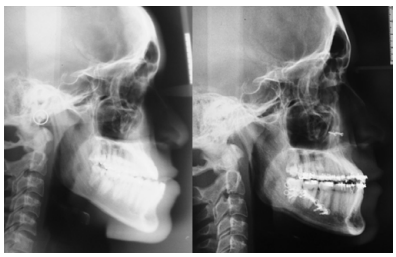

**Figure 7:** Pre and post lateral X –Ray.

**Figure 8:** Post treatment intraoral photographs.

**Figure 9:** Post treatment Panorex.

**Figure 10:** One year post treatment extra oral photographs.

**Figure 11:** One year post treatment intraoral photographs.

Two events could be responsible for the development of that complication: inadequate patient use of post-surgical elastics or development of bilateral condylar sag. When bilateral condylar sag occurs, the mandible rotates clockwise and backward causing class II occlusion with slight anterior open bite. However, the dental midlines will be coincidental [35].

In the present case, although a right molar class I relation and the inferior incisive inclination was not ideal (IMPA reduced at the end of treatment), significant changes in facial harmony were accomplished, correcting mandibular prognathism, obtaining a functional dental occlusion and the patient and his family were fully satisfied with the results obtained in such a short time.

Cases like this, involving orthognathic surgery, frequently demand 2 years or more time of treatment.

O Brien et al. [36] in a prospective study highlighted that the mean time of treatment is 33 months, i.e. about three years.

The "Surgery First" approach apparently triggers the Regional Acceleratory Phenomenon (RAP). RAP healing is a complex physiologic process with dominating features involving accelerated bone turnover and reduced regional bone densities. This term is commonly associated to corticotomy facilitation procedures. Following surgical wounding of cortical bone, RAP potentiates tissue reorganization and healing by a transient burst of local hard and soft tissue remodeling [37].

It may be hypothesized that osteotomies have a regional effect on the dental and osseous environment, likely resulting in physiologic conditions that are conducive to an accelerated alignment phase after surgery. The orthognathic surgery triggers a 3-4 month period of increased osteoclastic activity and metabolic changes in the dental alveolus that accelerate post-operative orthodontic tooth movement [38].

Aihara et al. [39] suggested that low energy laser irradiation facilitates differentiation and activation of osteoclast by up-regulation of RANK expression when low-energy laser irradiation (Ga-Al-As semiconductor laser) was applied to ratosteoclast precursor cells. This effect added to the significant effect on normal human osteoblast, increasing its proliferation without any cytotoxic effect on human preosteoclast cell cultures [40] suggest that the orthodontic dental movement acceleration results from over-stimulation of the osteoclast-osteoblast interaction. Combining this effect of laser irradiation with the RAP effect already described, there is a further potentiation of bone turnover and therefore, the rate of dental movement is increased during the active orthodontic movement phase.

It's important to clarify that the shorter treatment time could have been as a consequence of the original teeth alignment.

The authors are not acquainted of any previous report on the combined use of the surgery first protocol and low level laser therapy but as this is only a case report, further studies are necessary to obtain deeper insight and get more evidence on this subject.

## Conclusion

A class III Dento-Maxillo-Facial Anomaly was corrected in a patient during a full treatment time of 10 months, combining the "Surgery First" approached with low level laser therapy to potentiate the effect that both techniques provide to accelerate the rate of tooth movement randomized controlled clinical trials using the protocol presented in this report will be necessary to provide scientific evidence supporting the combined use of laser therapy and "Surgery First".

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### References

1. Proffit WR, White RP, Sarver DM (2003) Contemporary Treatment of Dentofacial Deformity. 1st ed. St. Louis, Missouri: single-Mosby.
2. Arad I, Jandu J, Bassett P, Fleming PS (2011) Influence of single-jaw surgery vs bimaxillary surgery on the outcome and duration of combined orthodontic-surgical treatment. Angle Orthod 81: 983-987.
3. Slavnic S, Marcusson A (2010) Duration of orthodontic treatment in conjunction with orthognathic surgery. Swed Dent J 34: 159-166.
4. Dowling PA, Espeland L, Krogstad O, Stenvik A, Kelly A (1999) Duration of orthodontic treatment involving orthognathic surgery. Int J Adult Orthodon Orthognath Surg 14: 146-152.
5. Ponduri S, Pringle A, Illing H, Brennan PA (2011) Peer Assessment Rating (PAR) index outcomes for orthodontic and orthognathic surgery patients. Br J Oral Maxillofac Surg 49: 217-220.
6. Luther F, Morris DO, Hart C (2003) Orthodontic preparation for orthognathic surgery: how long does it take and why? A retrospective study. Br J Oral Maxillofac Surg 41: 401-406.
7. Nagasaka H, Sugawara J, Kawamura H, Nanda R (2009) "Surgery first" skeletal Class III correction using the Skeletal Anchorage System. J Clin Orthod 43: 97-105.
8. Sugawara J, Aymach Z, Nagasaka DH, Kawamura H, Nanda R (2010) "Surgery first" orthognathics to correct a skeletal class II malocclusion with an impinging bite. J Clin Orthod 44: 429-438.
9. Yu CC, Chen PH, Liou EJ, Huang CS, Chen YR (2010) A Surgery-first approach in surgical-orthodontic treatment of mandibular prognathism--a case report. Chang Gung Med J 33: 699-705.
10. Villegas C, Uribe F, Sugawara J, Nanda R (2010) Expedited correction of significant dentofacial asymmetry using a "surgery first" approach. J Clin Orthod 44: 97-103.
11. Baek SH, Ahn HW, Kwon YH, Choi JY (2010) Surgery-first approach in skeletal class III malocclusion treated with 2-jaw surgery: evaluation of surgical movement and postoperative orthodontic treatment. J Craniofac Surg 21: 332-338.
12. Wang YC, Ko EW, Huang CS, Chen YR, Takano-Yamamoto T (2010) Comparison of transverse dimensional changes in surgical skeletal Class III patients with and without presurgical orthodontics. J Oral Maxillofac Surg 68: 1807-1812.
13. Liou EJ, Chen PH, Wang YC, Yu CC, Huang CS, et al. (2011) Surgery-first accelerated orthognathic surgery: orthodontic guidelines and setup for model surgery. J Oral Maxillofac Surg 69: 771-780.
14. Liou EJ, Chen PH, Wang YC, Yu CC, Huang CS, et al. (2011) Surgery-first accelerated orthognathic surgery: postoperative rapid orthodontic tooth movement. J Oral Maxillofac Surg 69: 781-785.
15. Dominguez A, Clarkson A, L pez R (2008) An in vitro study of the reaction of periodontal and gingival fibroblasts to low- level laser irradiation: A pilot study. J Oral Laser Applications 8:235-244.
16. Dominguez A, Morales M, Z iga P (2009) Cellular Effects related to the clinical uses of laser in orthodontics. J Oral Laser Applications 9:199-203.

17. Coombe AR, Ho CT, Darendeliler MA, Hunter N, Philips JR, et al. (2001) The effects of low level laser irradiation on osteoblastic cells. Clin Orthod Res 4: 3-14.

18. Fujihara NA, Hiraki KR, Marques MM (2006) Irradiation at 780 nm increases proliferation rate of osteoblasts independently of dexamethasone presence. Lasers Surg Med 38: 332-336.

19. Ozawa Y, Shimizu N, Kariya G, Abiko Y (1998) Low-energy laser irradiation stimulates bone nodule formation at early stages of cell culture in rat calvarial cells. Bone 22: 347-354.

20. Soleimani M, Abbasnia E, Fathi M, Sahraei H, Fathi Y, et al. (2012) The effects of low-level laser irradiation on differentiation and proliferation of human bone marrow mesenchymal stem cells into neurons and osteoblasts--an in vitro study. Lasers Med Sci 27: 423-430.

21. Dominguez A, Castro P, Morales M (2009) An In Vitro Study of the Reaction of Human Osteoblasts to Low-level Laser Irradiation. J Oral Laser Applications 9:21-28.

22. Saito S, Shimizu N (1997) Stimulatory effects of low-power laser irradiation on bone regeneration in midpalatal suture during expansion in the rat. Am J Orthod Dentofacial Orthop 111: 525-532.

23. Kawasaki K, Shimizu N (2000) Effects of low-energy laser irradiation on bone remodeling during experimental tooth movement in rats. Lasers Surg Med 26: 282-291.

24. Habib FA, Gama SK, Ramalho LM, Cangussú MC, Santos Neto FP, et al. (2010) Laser-induced alveolar bone changes during orthodontic movement: a histological study on rodents. Photomed Laser Surg 28: 823-830.

25. Cruz DR, Kohara EK, Ribeiro MS, Wetter NU (2004) Effects of low-intensity laser therapy on the orthodontic movement velocity of human teeth: a preliminary study. Lasers Surg Med 35: 117-120.

26. Dominguez A, Vel squez S (2010) Acceleration Effect of Orthodontic Movement by Application of Low-intensity Laser. J Oral Laser Applications 2:99-105.

27. Sousa MV, Scanavini MA, Sannomiya EK, Velasco LG, Angelieri F (2011) Influence of low-level laser on the speed of orthodontic movement. Photomed Laser Surg 29: 191-196.

28. Youssef M, Ashkar S, Hamade E, Gutknecht N, Lampert F, et al. (2008) The effect of low-level laser therapy during orthodontic movement: a preliminary study. Lasers Med Sci 23: 27-33.

29. Doshi-Mehta G, Bhad-Patil WA (2012) Efficacy of low-intensity laser therapy in reducing treatment time and orthodontic pain: a clinical investigation. Am J Orthod Dentofacial Orthop 141: 289-297.

30. Lim HM, Lew KK, Tay DK (1995) A clinical investigation of the efficacy of low level laser therapy in reducing orthodontic postadjustment pain. Am J Orthod Dentofacial Orthop 108: 614-622.

31. Fujiyama K, Deguchi T, Murakami T, Fujii A, Kushima K, et al. (2008) Clinical effect of CO(2) laser in reducing pain in orthodontics. Angle Orthod 78: 299-303.

32. Turhani D, Scheriau M, Kapral D, Benesch T, Jonke E, et al.,(2006) Pain relief by single low-level laser irradiation in orthodontic patients undergoing fixed appliance therapy. Am J Orthod Dentofacial Orthop 130:371-377.

33. Tortamano A, Lenzi DC, Haddad AC, Bottino MC, Dominguez GC, et al. (2009) Low-level laser therapy for pain caused by placement of the first orthodontic archwire: a randomized clinical trial. Am J Orthod Dentofacial Orthop 136: 662-667.

34. Domínguez A, Velásquez SA (2013) Effect of low-level laser therapy on pain following activation of orthodontic final archwires: a randomized controlled clinical trial. Photomed Laser Surg 31: 36-40.

35. Reyneke JP (2011) Reoperative orthognathic surgery. Oral Maxillofac Surg Clin North Am 23: 73-92, vi.

36. O'Brien K, Wright J, Conboy F, Appelbe P, Bearn D, et al. (2009) Prospective, multi-center study of the effectiveness of orthodontic/orthognathic surgery care in the United Kingdom. Am J Orthod Dentofacial Orthop 135: 709-714.

37. Shih MS, Norrdin RW (1985) Regional acceleration of remodeling during healing of bone defects in beagles of various ages. Bone 6: 377-379.

38. Wilcko WM, Wilcko T, Bouquot JE, Ferguson DJ (2001) Rapid orthodontics with alveolar reshaping: two case reports of decrowding. Int J Periodontics Restorative Dent 21:9-19.

39. Aihara N, Yamaguchi M, Kasai K (2006) Low-energy irradiation stimulates formation of osteoclast-like cells via RANK expression in Vitro. Lasers Med Sci 21: 24-33.

40. Dominguez A, Bayona G, Casas A (2012) In vitro response of Human Pre-Osteoclasts to low intensity Laser irradiation. Journal of research in Biology 2: 733-741.