PASSIVE SELF-LIGATION from A to Z

Edited by **Nasib Balut**, DDS, MS

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Dedication

I dedicate this book to my family—especially to Susu for your understanding, love, support, and everything you have done for me—and to my daughter, Nur, and my son, Samir, who have always been my focus, my love, and my happiness.

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Surgery-First Orthognathic Approach and PSL

Juan Fernando Aristizábal/Nasib Balut/
Carlos Villegas

14

When to Camouflage and When to Do Surgery

When a patient presents with significant skeletal problems, the two options for treatment are camouflage orthodontics to mask the skeletal problem or decompensation with a combined treatment of orthodontics and surgery. This decision depends on the diagnosis, the patient's age, the objectives in the profile change, patient compliance and comfort level (ie, fear of surgery), the severity of the bone discrepancy, and the patient's financial resources.

In cases of severe bone discrepancies, it is difficult to achieve favorable results in function, occlusion, profile, and smile esthetics without surgery. The surgery-first approach offers significant advantages, which are discussed later in this chapter.

However, when surgery is not an option for reasons of finances or patient willingness, camouflage orthodontics with the PSL system can still be fairly successful with proper diagnosis and good patient cooperation. Figure 14-1 shows the successful orthodontic treatment of a Class III case with PSL to mask the bone problem. This 21-year-old woman presented with a Class III skeletal pattern, a slightly concave profile, a slight anterior crossbite, and a Class III molar and canine relationship with moderate crowding in the maxillary arch. The patient was unwilling to undergo surgery, so nonextraction treatment was planned with the understanding that patient compliance with elastics would be essential to success (ie, she would need to wear them 20 to 22 hours per day). Figure 14-1d shows the treatment sequence with archwires and elastics used over the course of 14 months, and Fig 14-1e shows the final results of treatment. Even without surgery, a functional and esthetic result was achieved with good patient compliance and sound biomechanics.

IN THIS CHAPTER:

- When to camouflage and when to do surgery
- Surgical treatments
- Surgery-first orthognathic approach (SFOA)
- Clinical cases

Fig 14-1 *(a)* Initial extraoral and intraoral records of a 21-year-old woman with Class III skeletal pattern. *(b)* Radiography showing skeletal Class III pattern with normal growth direction. *(c)* PSL brackets with 0.014 CuNiTi archwire in the maxillary arch and 0.014 × 0.025 CuNiTi archwire in the mandibular arch after 3 months of treatment.

Fig 14-1 *(cont) (d)* Timing and sequence of wires used in the case. *(e)* Final results of treatment.

Surgical Treatments

When skeletal problems and expectations of facial change require the combined treatment of orthodontics and jaw surgery, biomechanics with customized PSL provide additional versatility in the planning and mechanical sequence of the case. The accuracy of the diagnosis is based on detailed 3D images of the craniofacial region.[1,2]

The digital preparation of a case in orthognathic surgery involves the following: digital models, anatomical reconstructions, and digital cuts.[3,4] Accurate planning is essential, and digital planning tools enable 3D surgical predictions.[5,6] 3D design, predictions, and digital manufacturing have dramatically improved the protocols for this type of treatment.[7,8]

In recent years, orthognathic surgery treatment concepts have undergone much change, particularly the reversal from traditional orthodontics before surgery to the surgery-first orthognathic approach.[7,9]

Surgery-First Orthognathic Approach (SFOA)

While reports of the surgery-first orthognathic approach date back to Dingman in 1944, Skaggs and Louisville in 1959, and Brachvogel and Hausamen in 1990,[10–12] Sugawara et al are credited as the first to establish surgery-first orthognathic approach (SFOA) protocols in an organized manner.[13,14] With this approach, surgery is performed very shortly after bracket placement.This has several advantages[1,15]:

- Facial appearance is improved from the first moment of surgery, which significantly affects the patient's self-esteem.
- The new conditions of soft tissue balance after surgery facilitate the correction of dentoalveolar compensation due to a better response of the adjacent soft tissues.
- These factors together with the regional acceleratory phenomenon (RAP) significantly reduce treatment duration.
- Light forces and PSL facilitate mechanical management in the immediate postsurgical period.

Therefore, in cases treated with SFOA, it is not necessary to place final splints, enabling clinicians to take advantage of the RAP from the beginning. This is only facilitated by Damon's classic mechanotherapy in phase 1: a wide slot with superelastic archwires with very low modulus of elasticity.[10,11,16]

While some maxillofacial surgeons are against the surgery-first approach because it is still controversial and requires a paradigm shift, this approach has been gaining popularity for many years, especially because the jaws and esthetics (a common concern in the orthognathic surgery patient) are corrected from the beginning.[1,3] This factor enhances the patient's cooperation and motivation. Surgery first also significantly reduces the duration of orthodontic treatment, eliminating the presurgical orthodontic phase altogether and increasing efficiency due to the RAP.[1,2,4]

The development of 3D imaging and the customization of orthodontic appliances have allowed clinicians to design interactive treatment plans that help to achieve the results expected by the patient. The combination of PSL, 3D surgical planning technologies (Fig 14-2), and a sophisticated bracket customization system enhances the possibility of success in combined orthodontic and orthognathic surgery cases. Understanding how the surgical patient will be decompensated (before or after surgery in SFOA cases) allows one to plan the optimal torque values for the treatment mechanisms with the appropriate software.[17]

There are several protocols for SFOA. Perhaps the most familiar for many orthodontists and/or surgeons is the protocol by Dr Junji Sugawara. In this protocol, it is suggested to make a pronounced surgical decompensation of the jaws—that is, make a Class III into a pronounced Class II immediately after surgery, using miniplates and intermaxillary elastics to bring the bony bases to their correct position. In this chapter, however, we suggest the SFOA protocol proposed by Dr Carlos Villegas, which consists of 10 steps to be followed.

1. Diagnosis

As with any pathology or condition, diagnosis is the first and most crucial step. This is done mainly based on the patient's clinical characteristics and is confirmed or complemented with diagnostic aids such as panoramic, lateral cephalometric, and periapical radiography as well as CBCT imaging if available. The orthodontist must also review the patient's dental casts to determine if some previous decompensation or significant occlusal interferences must be addressed prior to surgery to achieve better occlusal stability. This is known as "surgery early."

2. Orthodontic and surgical treatment plan

This should be directed by the surgeon in coordination with the orthodontist. The surgeon should determine the surgical movements that suit the patient from the esthetic aspect and if they are technically feasible to perform. The orthodontist will then determine where the patient's occlusion should

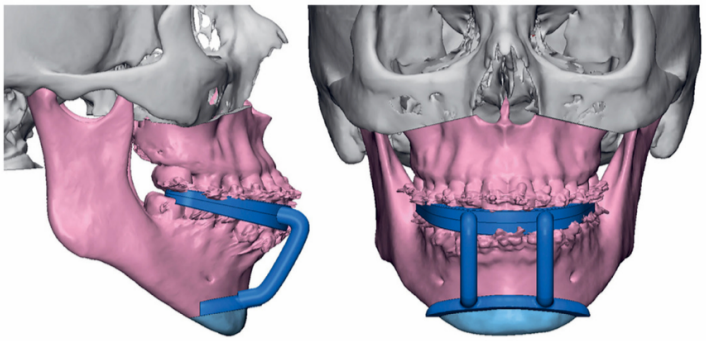

Fig 14-2 3D planning and stereolithographic templates for surgery.

be after surgery because the entire postsurgical orthodontic process will follow. The orthodontist will also determine if any skeletal anchorage (miniscrews or miniplates) will be required during the postsurgical orthodontics, as this could be placed during the surgical procedure.

3. Placement of brackets and tubes

It is advisable to place brackets and tubes 1 day before surgery. They could be placed several days before the surgery, but because they do not have any function, they would only bother the patient's lips or run the risk of falling off if the patient is not careful enough. It is essential not to place any archwire because this would cause movement of the teeth, which would prevent the surgical guides or splints from fitting properly.

4. Model surgery vs virtual surgery planning

Once the movements to be performed are agreed upon between the surgeon and orthodontist, the surgeon performs model surgery the day before the actual surgical procedure. If there is virtual planning, this will be done some days before the surgery so that the surgical guides can be printed and ready for the day of surgery.

5. Placement of orthodontic archwires before starting surgery

In this protocol, orthodontic archwires are placed just before the surgery begins. This can be done by one of the orthodontic assistants or the orthodontist in the office, which is more practical for them, or in the hospital preparation room before the patient enters the operating room. Our recommendation is to place a standard nickel-titanium archwire used for alignment and leveling in a conventional orthodontic case. In our protocol, we do not leave the final surgical guide in the mouth, which would interfere with dental movements. Only in cases where a surgical expansion of the maxilla is performed do we leave a palatal splint in the mouth, like a Hawley plate, to maintain the expansion during the first 6 weeks.

6. Surgery

The surgery itself is performed conventionally. If necessary, maxillary expansion is performed in the midline, or LeFort 1 osteotomy is performed in three pieces, which is very useful when there are problems or transverse interferences. Any necessary skeletal anchorage is also placed to facilitate postsurgical orthodontics. Strong elastics for intermaxillary fixation are routinely placed for 1 week. These elastics are usually attached to the pins (hooks) of the brackets. The

patient must maintain a liquid diet during the first week after surgery.

7. Postsurgical monitoring

Postsurgical monitoring is performed by the surgeon 1 week later, at which time the strong elastics are removed and softer elastics are placed. The patient may remove these elastics to eat, perform oral hygiene, and perform passive mouth-opening exercises. At this point, the patient may commence a very soft diet (ie, still no chewing), eating foods that can be mashed with the tongue against the palate. The patient is also instructed to massage his or her face with circular movements using the fingertips to apply moisturizing cream, which will reduce any edema by facilitating lymphatic drainage. Subsequently, a follow-up appointment is made after 8 days to verify that everything is fine. If necessary, the elastic vector can be changed; for example, it is important to correct it in the initial stages if there is any midline deviation.

8. Orthodontic monitoring

It is recommended that the orthodontist follow up with the patient regularly. Because teeth move faster after surgery, orthodontic checkups must be done every 2 or 3 weeks to monitor tooth movement and occlusion changes and apply the necessary correctives to speed up the treatment. In the authors' opinion, the orthodontist must take control of the case as soon as possible after the surgery because of the importance of elastic and orthodontic management.

9. Surgeon monitoring

It is recommended that the surgeon also follow the patient's progress. After 4 weeks, the patient can start chewing soft foods, and by 6 weeks, this graduates to a diet without restriction. Also at 6 weeks, the patient should perform manual exercises to recover original mouth opening. If, after about 3 months, the patient does not recover the mouth opening, assisted therapy with tongue depressors will be prescribed, or the patient will be referred to physiotherapy.

10. Completion of the case and retention

Once the orthodontist has finished the case, a suitable retention system will be employed. These retention controls are done conventionally.

Conclusion

PSL systems allow predictable approaches in camouflage cases, particularly when customized prescription systems are also used. Together with digital planning, the SFOA protocol in conjunction with the biomechanical systems of PSL guarantee efficient treatments with optimal force levels to protect the periodontal area with biologic control.

Clinical Cases

Case 1

Diagnosis: A 34-year-old woman presenting facial asymmetry and bite instability. In the extraoral examination, the patient presented a straight profile, with a facial asymmetry due to a maxillary deviation to the right, an anterior crossbite with occlusal instability, and absence of maxillary permanent canines (Fig 14-3). The cephalometric radiograph showed maxillary retrognathism with a vertical pattern, and the panoramic radiograph confirmed the absence of maxillary canines (Fig 14-4).

Treatment objectives: Solve the patient's asymmetry and improve the occlusal and functional conditions.

Treatment alternatives: This case could be managed with customized appliances and conventional orthodontics or SFOA. Because the patient wanted and expected immediate change, SFOA was selected.

Treatment progress: Figure 14-5 shows the planning result with the customized appliance software. Note that it is essential to manage the torque compensation in this software. This tool should be turned off only in those surgical cases that are not dentoalveolar compensated, because it will not be necessary to improve the dental angulation; all the volumetric changes will be carried out with the surgery. Sometimes it is advisable to manually overcompensate the torque with the Approver to optimize mechanisms in the immediate postoperative period and take advantage of the RAP in its most crucial phase.[2] Figure 14-6 shows the torque values for this case.

Fig 14-3 *(a to i)* Initial extraoral and intraoral photographs.

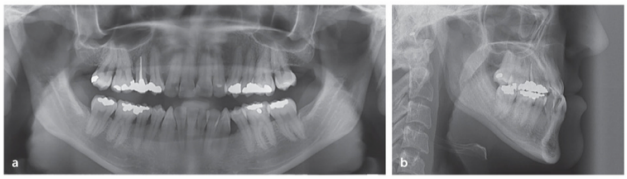

Fig 14-4 *(a and b)* Initial panoramic and cephalometric radiographs.

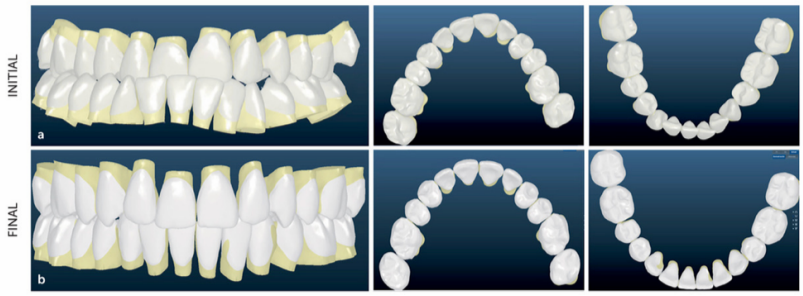

Fig 14-5 Digital setup with Approver. *(a)* Initial occlusion. *(b)* Final setup.

1	3.9	5.1	1
2	4.8	7.2	2
3	-	-	3
4	-1.4	1.6	4
5	-2.4	1.5	5
6	-9.1	-4.6	6
7	-4.6	-1.3	7
1	4.3	6.2	1
2	5.8	2.7	2
3	-0.3	0.5	3
4	-5.3	-	4
5	-10.1	-0.7	5
6	-16.8	-12.4	6
7	-14.9	-12.4	7

Fig 14-6 Table of torque values for this patient.

Fig 14-7 Progress 2 weeks after surgery.

After taking silicone impressions, the Insignia SL custom brackets were fabricated. These brackets were placed 2 days before surgery, and on the day of surgery, just before intubating the patient, 0.014 CuNiTi archwires were installed in both arches. The patient had a LeFort advancement of 5 mm and left the operating room with short Class III elastics with an asymmetric component.

Postsurgical orthodontics would follow this archwire sequence in both arches: 0.014 CuNiTi, 0.014 × 0.025 CuNiTi, 0.018 × 0.025 CuNiTi, and 0.019 × 0.025 TMA.

Note the progress of the case 2 weeks after surgery, still in phase 1 of postsurgical orthodontics, with light wires, elastic management, and NiTi open springs to create space to solve the malocclusion (Fig 14-7). Two months after surgery, the patient advanced to phase 2 of treatment with the 0.014 × 0.025 CuNiTi archwires in both arches (Fig 14-8).

Treatment results: After 8 months of orthodontic treatment (Fig 14-9), the brackets were removed. Figure 14-10 shows the final results with high occlusal stability, alignment, and resolution of facial asymmetry. Figure 14-11 shows the patient after 3 years of retention, with adequate stability of the orthodontic-surgical treatment.

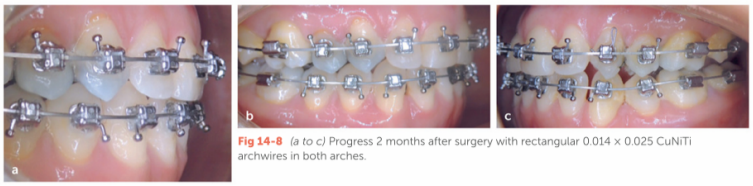

Fig 14-8 *(a to c)* Progress 2 months after surgery with rectangular 0.014 × 0.025 CuNiTi archwires in both arches.

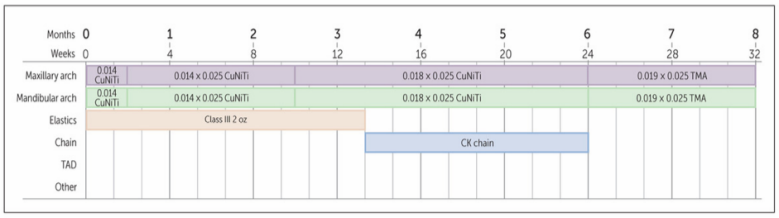

Fig 14-9 Archwire and elastic sequence following surgery.

Fig 14-10 *(a to i)* Final extraoral and intraoral photographs.

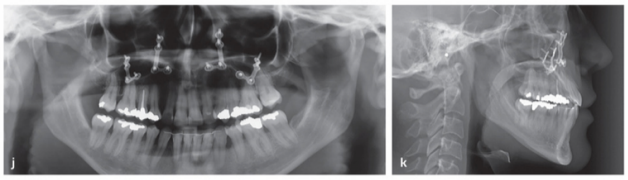

Fig 14-10 *(cont) (j and k)* Final panoramic and cephalometric radiographs.

Fig 14-11 *(a to g)* Follow-up photographs 3 years into retention.

Case 2

Diagnosis: A 21-year-old woman, referred by the maxillofacial surgeon, presented with a concave profile, slightly protruded lower lip, and slight mandibular prognathism. The diagnosis was Class III malocclusion with a slight anterior crossbite and crowding in the mandibular arch. Skeletally, she presented a Class III pattern due to significant mandibular growth and slight retroclination of the mandibular incisors (Fig 14-12).

Treatment objectives: The treatment's main objectives were to improve the profile, achieve adequate function by obtaining Class II molar and canine relationships, correct the crowding mainly in the mandibular arch, and achieve an esthetic smile.

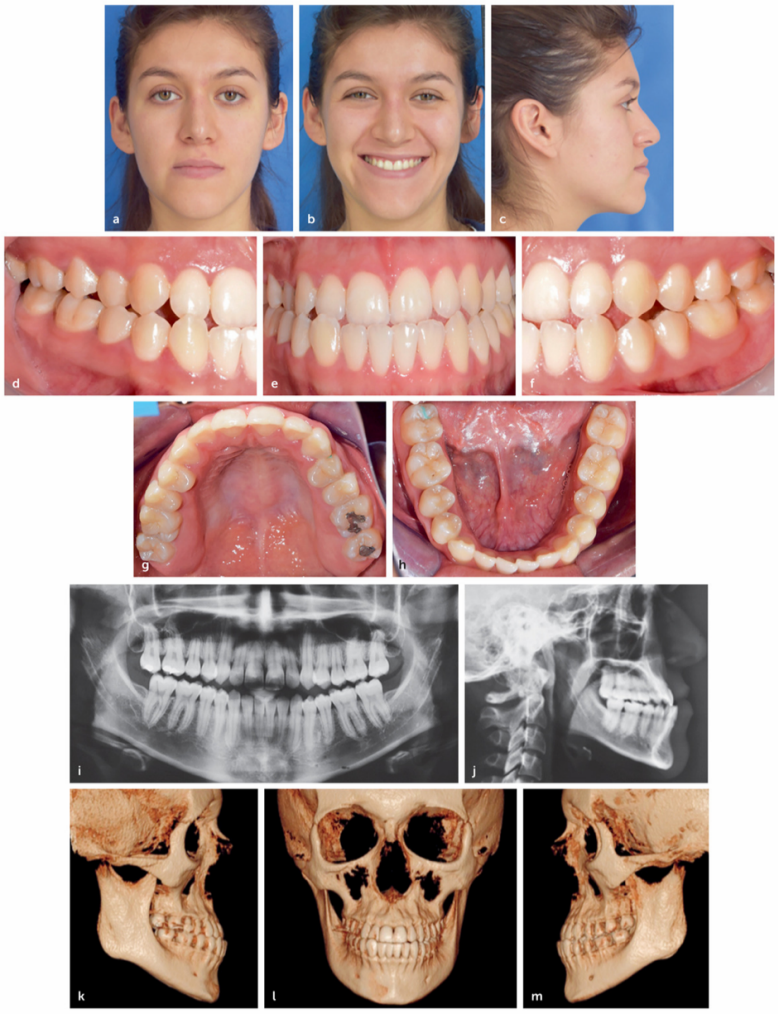

Fig 14-12 *(a to m)* Initial photographs and imaging showing skeletal Class III pattern.

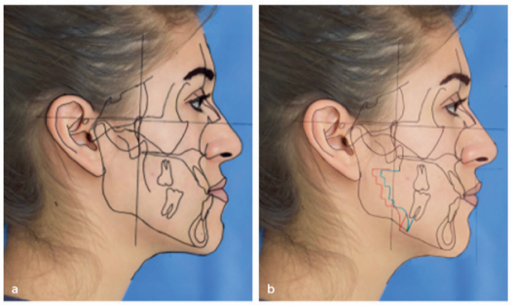

Fig 14-13 *(a and b)* Surgical planning for mandibular recession surgery (bilateral mandibular sagittal osteotomy).

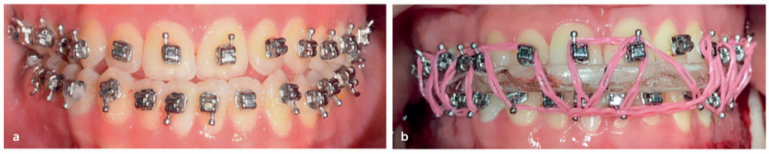

Fig 14-14 *(a)* Brackets and hooks placed 1 day before surgery without wires. *(b)* Occlusion during attachment in the operating room.

Fig 14-15 *(a and b)* Smile and profile comparisons before and 5 weeks after surgery.

Treatment alternatives: There was no alternative combined surgical-orthodontic treatment with surgery first for mandibular recession (Fig 14-13).

Treatment progress: One day before surgery, Damon Q brackets with hooks were placed. The torque selection was high torque for all canines, low torque for the maxillary incisors, and standard torque for the mandibular incisors.

Surgical planning was performed for mandibular recession surgery. The objective was to achieve anteroposterior correction, correcting the lower lip's protuberance and increasing the volume of the middle third of the face. The patient underwent surgery without orthodontic wires. A bilateral mandibular osteotomy was performed on the ramus, fixing the osteotomy with a miniplate and bicortical screws bilaterally. The surgical splint maintained the horizontal and vertical overbite results of the planned surgery, obtaining a slight positive horizontal overbite and a slight Class II molar and canine relationship. The splint was attached with intermaxillary elastics (Fig 14-14).

Fig 14-16 *(a to c)* Intraoral photographs of progress 5 weeks after surgery.

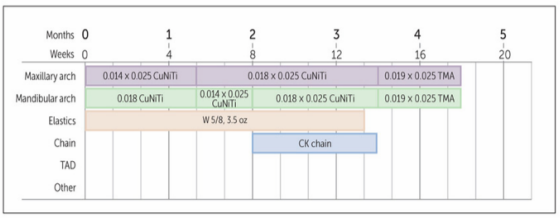

Fig 14-17 Archwire and elastic sequence following surgery.

In the operating room, after verifying the occlusion and the rigid fixation in place, a 0.016 CuNiTi wire was placed in the mandibular arch due to crowding in the mandibular right canine area, and a 0.014 × 0.025 CuNiTi wire was placed in the maxillary arch. An immediate soft tissue improvement was observed only 8 days after the surgical procedure despite the natural inflammation process.

Two weeks after surgery, the patient began using "W" shaped intermaxillary elastics (5/8, 3.5 oz). Five weeks after surgery, an 0.018 × 0.025 CuNiTi archwire was placed in the maxillary arch, and a 0.014 × 0.025 CuNiTi archwire was placed in the mandibular arch. Photographs taken at this time show a dramatic difference in profile (Fig 14-15). Interproximal reduction (IPR) was also performed on the mandibular anterior teeth to assist in the alignment of the mandibular anterior segment (Fig 14-16).

Eight weeks after surgery, a closed elastic chain was placed from first molar to first molar in both arches. Ten weeks after surgery, intrusion bends were placed to the maxillary and mandibular anterior teeth due to increased contact, and 0.018 × 0.025 CuNiTi archwires were placed in both arches. At week 14, 0.019 × 0.025 TMA archwires were placed in both arches, keeping the intrusion bends in the anterior teeth to avoid occlusal trauma in the anterior area (Fig 14-17).

Treatment results: After 18 weeks of treatment, all the appliances were removed, completing the orthodontic-surgical treatment in only 4.5 months, which confirms the treatment time advantage of SFOA. The final records show improvement in the patient's facial and dental esthetics, including dramatic improvement of the profile, correction of the Class III skeletal pattern, and improvement of the horizontal and vertical overbite. The dental arches are now in alignment in a solid Class I occlusion. Fixed retainers were placed from canine to canine in both arches for long-term retention (Fig 14-18).

Fig 14-18 *(a to h)* Final photographs after 4.5 months of treatment. *(i and j)* Final panoramic and cephalometric radiographs. *(k)* Cephalometric superimpositions.

Conclusion

Traditional orthodontic-surgical treatment consists of three phases: surgical decompensation to expose the true nature of the malocclusion and alignment, orthognathic surgery to correct the revealed skeletal discrepancies, and postoperative orthodontics to finalize the case and achieve optimal results after surgery.[18,19] Despite the effectiveness of the conventional approach for surgical cases, it leads to functional and esthetic discomfort for the patient, and this has been a significant disadvantage in the history of this technique.[20] In addition to the time needed for orthodontic decompensation, which averages 12 to 24 months, the postoperative orthodontic phase requires another 7 to 18 months to finalize the treatment.[21,22]

The use of PSL brackets, thermoactivated wires, and RAP can dramatically accelerate and reduce the postoperative treatment duration.[23] The RAP accelerates bone remodeling, creating a more manageable and more docile environment where teeth can move with less resistance.

The comprehensive management of orthodontic-surgical cases requires a contemporary digital approach. The 3D planning of surgical movements and the biomechanical approach using PSL and customized appliances offer a more efficient treatment approach. Combined with contemporary approaches such as SFOA, treatment time can be drastically reduced and patient satisfaction dramatically improved.

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