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Orthognathic Surgical Splint for correction of Skeletal Class III Malocclusion: A Multidisciplinary Clinical Approach

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ABSTRACT

Skeletal Class III malocclusion presents significant functional and esthetic challenges, often necessitating orthognathic surgical intervention. This case report details the conventional fabrication of an orthognathic surgical splint to assist mandibular repositioning in a young adult male undergoing bilateral sagittal split osteotomy. A coordinated approach between the departments of Orthodontics, Oral Surgery, and Prosthodontics enabled accurate diagnosis, pre-surgical decompensation, and model surgery on a semi-adjustable articulator. Using facebow transfer, split-cast mounting, and mock mandibular setback, a surgical splint was fabricated in clear acrylic to guide intraoperative alignment of the jaws. The splint facilitated precise mandibular positioning during surgery and ensured the transfer of the planned occlusion to the operating field. Postoperative healing was uneventful, and final occlusion was refined through orthodontic finishing. This case highlights the continued relevance of conventional techniques in achieving successful orthognathic outcomes when implemented through meticulous planning and interdisciplinary collaboration.

Keywords: *Skeletal Class III malocclusion, orthognathic splint, bilateral sagittal split osteotomy, prosthodontics, model surgery*

1. INTRODUCTION

Skeletal Class III malocclusion poses a formidable clinical challenge because it involves a basal bone discrepancy rather than merely a dento-alveolar irregularity [1]. Patients frequently present with a prognathic mandible, a retrusive maxilla, or a combination of both, culminating in reverse overjet, compromised masticatory efficiency, distorted speech patterns, and psychosocial distress stemming from facial disharmony [2]. Contemporary management centres on a combined orthodontic–surgical protocol: presurgical orthodontic decompensation, orthognathic surgery to realign the jaws, and postsurgical orthodontic detailing. Within this sequence, the orthognathic surgical splint is indispensable [3]. It records the intended three-dimensional jaw relationship and guides the surgeon during osteotomy fixation, safeguarding the accuracy of skeletal movements and the integrity of the planned occlusion.

The creation of a reliable splint demands meticulous coordination among orthodontists, prosthodontists, and maxillofacial surgeons. Accurate facebow transfer, split-cast mounting, and mock surgical simulation on an articulator translate the virtual treatment plan into a physical guide. During bilateral sagittal split osteotomy or Le Fort procedures, the splint acts as an intraoperative "blue-print," ensuring that bony segments seat precisely in their predetermined positions while compensating for intraoperative variables such as neuromuscular tone and condylar seating [3]. Postoperative stability, facial esthetics, and functional rehabilitation are thus intimately linked to the precision of the splint.

Despite advances in virtual surgical planning and CAD-CAM splints, conventional laboratory techniques remain widely practiced and continue to yield predictable results when executed under stringent protocols. The present case report illustrates the stepwise fabrication and clinical application of an orthognathic splint in the correction of skeletal Class III malocclusion, underscoring the critical role of interdisciplinary collaboration and prosthodontic accuracy in achieving harmonious, stable, and patient-centred outcomes.

2. CASE REPORT

A 23-year-old male patient was referred to the Department of Prosthodontics for the fabrication of an orthognathic surgical splint as part of the interdisciplinary management of skeletal Class III malocclusion. The pre-operative photographs are depicted in Figure 1. The patient had previously undergone comprehensive pre-surgical orthodontic treatment in the Department of Orthodontics, which included alignment, leveling, and decompensation of the dental arches to prepare for orthognathic surgical correction. The treatment plan had been developed collaboratively by the Departments of Orthodontics, Oral and Maxillofacial Surgery, and Prosthodontics, with a consensus to perform a mandibular setback using bilateral sagittal split osteotomy (BSSO).

Figure 1: Preoperative A) Extraoral view, B) Intraoral view, and C) Lateral cephalogram

Upon referral, diagnostic records including intraoral and extraoral photographs, lateral cephalogram, orthopantomogram, and study models were evaluated. Preliminary maxillary and mandibular impressions were made using irreversible hydrocolloid (alginate) material. These were poured immediately with Type III dental stone to obtain working models. A facebow transfer was performed using a standard facebow device (Hanau™ Spring-Bow) to accurately orient the maxillary cast in relation to the hinge axis of the articulator (Hanau Wide-Vue semi-adjustable articulator). A centric relation record was obtained with wax bite registration after verification on the patient.

The maxillary cast was mounted using the facebow record. Subsequently, the mandibular cast was mounted using the centric relation record. A split-cast mounting technique was used to enable ease of repositioning the mandibular segment. The mounting was then secured with mounting plaster, and the articulator was checked for accuracy of occlusal contacts and stability.

Following this, a mock surgical procedure was carried out on the articulator. Based on the predetermined surgical plan provided by the Department of Oral and Maxillofacial Surgery, the mandibular cast was sectioned posterior to the canine regions on both sides, simulating a bilateral sagittal split. The cast was repositioned posteriorly and superiorly in accordance with the planned setback values, ensuring occlusal harmony with the maxillary arch in the new position. This simulated the intended postoperative occlusion. The procedures from facebow transfer to planned mandibular setback simulation and fabrication of orthognathic splints are depicted in Figure 2.

Once the final position of the mandibular cast was verified and approved in consultation with the orthodontist and surgeon, a rigid wax base was adapted over the mandibular teeth in the corrected position. A transparent self-cure acrylic resin (clear cold-cure acrylic) was used to fabricate the orthognathic splint over this wax template. The splint extended over the occlusal and incisal surfaces, stabilizing both posterior and anterior occlusion. Special care was taken to avoid interference with surgical access or placement of intermaxillary fixation screws.

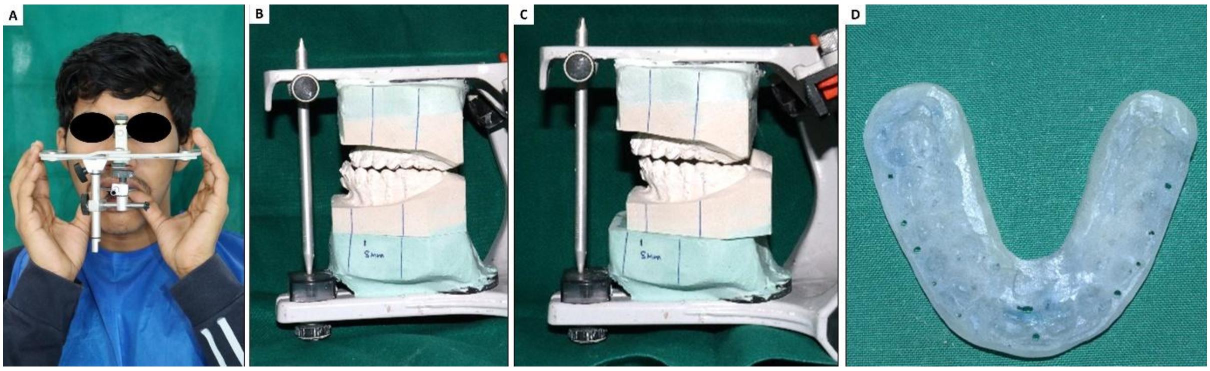

Figure 2: A) Facebow record; B) Pre-correction mounting; C) Mandibular setback simulated on articulator; D) Orthognathic splint

The finished splint was carefully trimmed, polished, and checked for any internal irregularities or pressure points. It was then placed intraorally for trial fitting. The splint was seated passively without discomfort and confirmed to accurately replicate the intended occlusion. Instructions were given to the surgical team regarding its use during BSSO, where it would serve to guide the repositioned mandible into its new orientation relative to the maxilla during fixation (Figure 3).

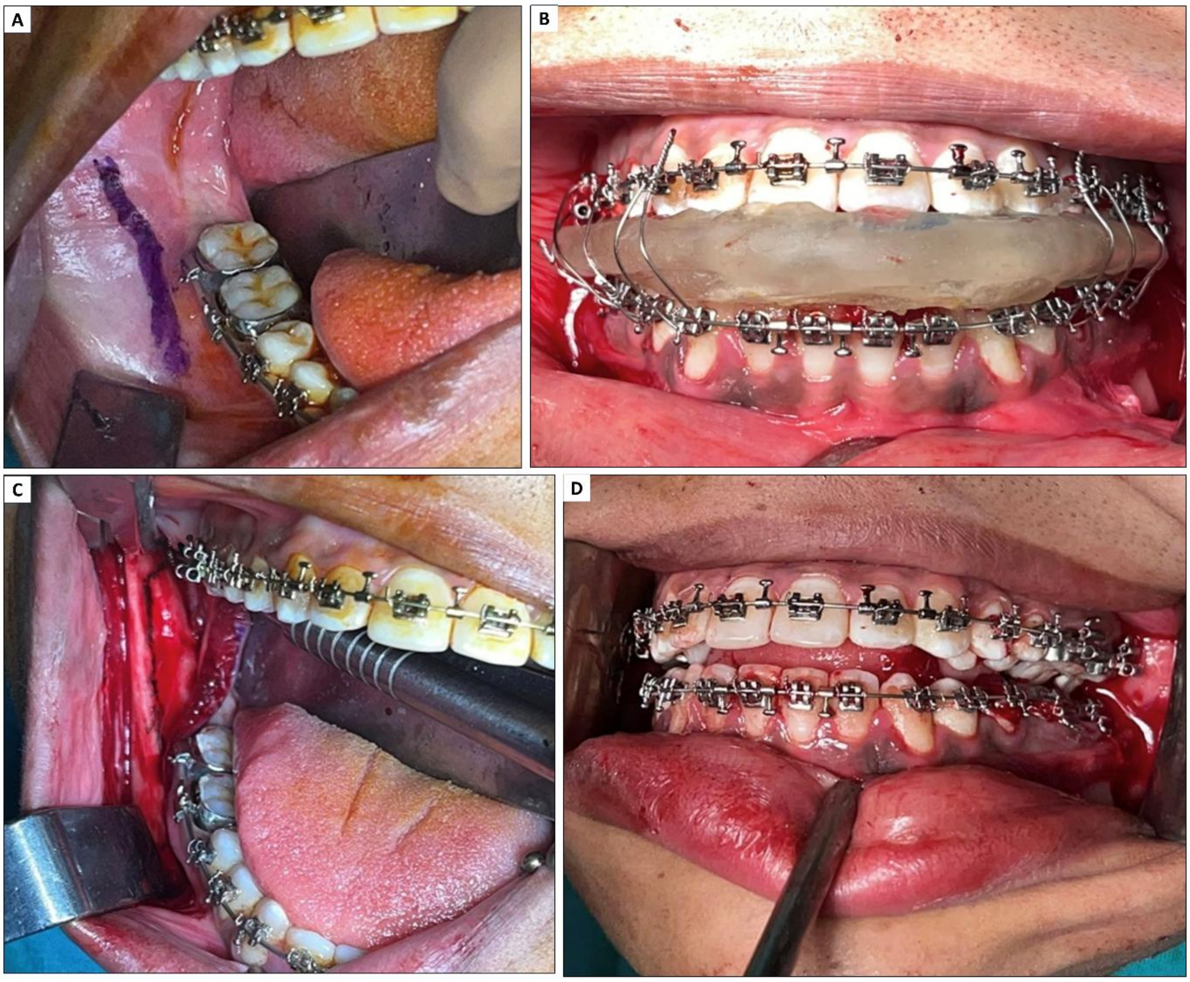

Figure 3: Vestibular incision marking extending upwards along the ramus; B) Full thickness mucoperiosteal flap reflected & BSSO cuts marked; C) Mandible repositioned with setback of 8 mm using guiding plates & occlusion established with IMF; D) Achievement of passive occlusion

Postoperatively, the splint was used intraoperatively to maintain the occlusion during fixation and intermaxillary wiring. The surgical procedure was uneventful, and the occlusion achieved matched the simulated setup on the articulator (Figure 4). The patient was reviewed regularly in coordination with the Orthodontic department for postoperative orthodontic refinement and stabilization of occlusion.

Figure 4: Post-operative A) Extraoral view, B) Intraoral view, and C) Lateral cephalogram

3. DISCUSSION

Skeletal Class III malocclusion remains one of the more demanding dentofacial discrepancies to correct because the deformity is rooted in basal bone disharmony rather than in dento-alveolar compensation alone. Although BSSO provides a predictable means of mandibular setback, long-term function and esthetics depend on transferring the three-dimensional surgical plan to the operating field with millimetric accuracy. Traditional model surgery with casts mounted on a semi-adjustable articulator via a facebow transfer has served this purpose for decades and continues to be widely practiced in centres where virtual surgical planning (VSP) is not yet routine. Hammoudeh et al. reported that stone-model surgery remains accurate and reproducible, albeit labour-intensive, reinforcing its value when executed meticulously [4].

In the present case, the prosthodontic workflow followed the classic analogue protocol: an infra-orbital facebow transfer, centric-relation waxing, split-cast mounting, and a mock BSSO on the articulator. Walker and colleagues demonstrated that using an orbital-pointer or spirit-level facebow can reduce maxillary mounting errors to within 1° of true occlusal cant, thereby limiting downstream occlusal discrepancies [5]. Repositioning the mandibular cast in the predetermined setback distance reproduced the surgeon's prescription while allowing visual confirmation of intercuspation before acrylic processing. Fabricating the splint in clear self-cure resin conferred two advantages: intra-operative visibility of occlusal landmarks and the possibility of minor chairside adjustments with acrylic burs if soft-tissue impingement occurred.

Post-operative findings in this patient paralleled those of larger cohort studies that have documented low relapse rates after rigid-fixation BSSO. Rao et al. observed mean horizontal relapses of approximately 2–3 mm at B-point and pogonion, values considered clinically acceptable when rigid miniplate fixation is used [6]. More recent reviews emphasise that even when minor positional changes occur, occlusal stability can usually be maintained with coordinated orthodontic finishing and early functional mobilisation [7]. In the current report, the splint secured intra-operative condylar seating and protected the planned incisal overjet; subsequent orthodontic detailing required only light inter-arch elastics, suggesting that the analog workflow provided sufficient accuracy for single-jaw correction.

Nevertheless, the analogue technique is not without limitations. Each manual step including impression taking, facebow registration, cast sectioning, and acrylic polymerisation, introduces potential cumulative error. VSP combined with computer-aided design and manufacturing (CAD/CAM) of splints has shown sub-millimetric transfer precision while reducing laboratory time. Delpachitra et al. found that CAD/CAM splints reproduced virtual plans in 49 orthognathic patients with high reliability across sagittal, vertical, and transverse planes [8]. Similarly, a systematic comparison of traditional versus 3-D planning concluded that digital splints match the accuracy of model surgery but require a fraction of the benchwork time, albeit at increased upfront cost and with technological learning curves for the clinical team [4]. For institutions where integrated digital workflows and cone-beam CT–driven segmentation are accessible, the shift toward VSP is likely to become the standard.

An additional strength of the current case lies in the seamless interdisciplinary coordination. Presurgical orthodontic decompensation eliminated dental compensations that could mask the skeletal discrepancy, thereby facilitating a pure bony correction. Immediate communication between surgeon and prosthodontist during mock surgery permitted fine-tuning of ramal rollback and occlusal stops, and the splint's design purposefully avoided posterior palatal coverage so that self-tapping fixation screws could be placed without interference. Such details illustrate how analogue processes can still meet contemporary accuracy demands when every discipline adheres to shared checkpoints.

The case does, however, highlight areas for refinement. First, the reliance on irreversible hydrocolloid impressions can be challenged by digital intra-oral scanning, which eliminates casting distortion and enables direct export into surgical planning software [9]. Second, mounting errors could be further reduced by incorporating a kinematic hinge-axis transfer or by validating the articulator position with CBCT-based superimposition [10]. Although a single-case outcome is illustrative, the lack of quantitative cephalometric superimposition pre- and post-surgery limits objective assessment of skeletal relapse; future reports should incorporate three-dimensional voxel-based registration at defined time points to substantiate clinical impressions of stability.

4. CONCLUSION

The present case report describes a well-executed conventional workflow can still deliver precise surgical transfer for mandibular setback in skeletal Class III malocclusion. The splint ensured intra-operative accuracy, facilitated early functional occlusion, and supported efficient postoperative orthodontic finishing. As digital planning becomes increasingly accessible, hybrid models—combining face-to-face interdisciplinary calibration with computer-generated splints—may offer the optimal balance between precision, efficiency, and cost. Continued comparative studies, ideally randomised or prospective cohort designs with long-term follow-up, are warranted to delineate the circumstances in which analogue craftsmanship suffices and those in which full digital integration confers a measurable clinical advantage.

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