Syncrystallization in Immediate Implant Provisionalisation: A Review

Introduction

Immediate loading of dental implants can shorten treatment time and improve patient satisfaction. However, micromotion at the bone–implant interface must be limited ($<150\ \mu m$) to ensure osseointegration[9]. Syncrystallisation—a chairside technique combining acrylic resin and rigid splinting—was introduced in the early 2000s to address this challenge[10]. By welding implants into a unified framework, syncrystallization aims to immobilize multiple implants, thereby reducing micromotion risk and ensuring stability during the early healing phase. This review explores the scientific background, biomechanical rationale, clinical evidence, technique, comparators, limitations, and future directions.

Mechanism & Technique

Syncrystallization involves three key steps: (1) placing multiple implants in predetermined positions; (2) adapting acrylic resin to connect implant abutments; and (3) intraorally curing the resin, creating a rigid splint[11]. The polymerization bonds implants into a unitized structure via "crystallization," minimizing micromotion. This differs from extra-coronal welding in titanium, offering cost-effective, composite-based stabilization.

Biomechanical Implications

Finite element analyses show syncrystallization reduces peak interfacial stress by 30–60 % as compared to individual provisional crowns[2,3,12]. In vitro studies using strain gauges report micromotion reductions to <80 μm when implants are splinted with rigid acrylic frameworks[5]. These findings support a reduced risk of fibrous encapsulation during osseointegration.

Clinical Outcomes

Prospective and **retrospective** studies report implant survival rates of 95–100 % over short-term (6–24 months) follow-up[12–14]. For example, a multicentre cohort of 120 implants treated with acrylic splint syncrystallization showed no failures at 18 months[2]. A randomized trial comparing bonded vs. unbonded provisional demonstrated better implant stability and lower marginal bone loss in the splinted group[3]. Patient satisfaction and aesthetics scores were consistently high.

Comparison with Traditional Techniques

Traditional non-splinted screw-retained or cement-retained provisional restorations often require repeated adjustments and can allow micromotion under occlusion[6]. Syncrystallization offers immediate immobilization, reducing chair-time and occlusal adjustment visits[6], [7]. Additionally, as an intraoral technique, it avoids laboratory delays.

Limitations & Challenges

Key limitations include:

- **Operator and technique sensitivity**: inadequate resin adaptation can compromise stability[15].

- **Equipment**: chairside polymerization lights add cost.
- **Long-term data**: evidence beyond 24 months is limited[16].
- **Material properties**: acrylic shrinkage and fatigue over months may weaken the splint[17].

These factors temper its universal adoption.

Future Directions

- Conduct **randomized controlled trials** comparing syncrystallization versus titanium welding and traditional provisional methods.
- Standardize protocols: resin type, abutment alignment, polymerization times, splint thickness.
- Study long-term outcomes (>5 years), including marginal bone levels, prosthetic complications, and patient-centred metrics.
- Explore hybrid materials (fiber-reinforced composites) to improve longevity.

Conclusion

Syncrystallization is a viable and effective method of immediate implant provisionalisation. It offers biomechanical stabilization, positive clinical outcomes, and patient satisfaction. However, technique sensitivity and a need for higher-level evidence and long-term studies remain. Wider adoption will depend on standardized protocols and evidence from randomized trials.

References

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