

COMPARISON OF CONVENTIONAL AND DIGITAL
PROTOCOLS FOR IMPLANT POSITION TRANSFER IN
FULL-ARCH ALL-ON-X REHABILITATION

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Background

Full-arch implant rehabilitation for completely edentulous patients requires highly accurate transfer of implant positions from the mouth to the working stage. In screw-retained All-on-X restorations, even limited inaccuracy during impression taking or digital registration may compromise passive fit, increase mechanical stress within the implant-abutment-framework complex, and raise the risk of screw loosening, framework strain, or biologic complications. The problem is amplified in the edentulous arch because stable landmarks are limited, the mucosa is mobile, moisture control is difficult, and error may accumulate across a long span. Distal implants are also frequently tilted, which complicates implant-position capture and makes geometric deviation more clinically relevant. Thus, the main question is not whether a protocol is conventional or digital, but how reliably it transfers implant positions under full-arch conditions.

Objective

To critically summarize the present evidence on four major approaches for implant position transfer in full-arch All-on-X rehabilitation: conventional impressions, intraoral scanning, photogrammetry, and reverse scan body workflows.

Materials and Methods

This extended abstract is based on a critical narrative synthesis of 36 thematically relevant publications published predominantly between 2017 and 2026. The reviewed evidence included systematic reviews, meta-analyses, clinical studies, in vitro investigations, and selected practice-oriented reports. The analysis focused on trueness, precision, interimplant deviation, angular error, workflow complexity, operator dependence, and the clinical implications of misfit. A formal meta-analysis was not performed because the available studies were markedly heterogeneous with respect to scanner systems, scan body designs, implant configurations, reference methods, and reported endpoints.

Results

The available literature does not support a simplistic digital-versus-conventional dichotomy. Instead, each workflow demonstrates its own balance of strengths, limitations, and sources of error.

Conventional impressions remain clinically relevant because they often show high trueness in complete-arch conditions and may offer the safest option when the cost of error is high. Their main disadvantages are greater chairside burden, laboratory dependence, and lower workflow efficiency.

Intraoral scanning improves patient comfort, facilitates digital integration, and often shows strong repeatability. However, in complete edentulism it remains sensitive to long-span stitching error, limited landmarks, moisture, scan-body visibility, scan strategy, and implant angulation. Modified scan bodies, scan aids, and auxiliary landmarks may improve results, but they

do not fully eliminate the structural vulnerability of full-arch scanning to cumulative error.

Photogrammetry occupies a distinct role because it is designed primarily for highly accurate capture of implant positions rather than for complete soft-tissue registration. It frequently shows excellent values for interimplant distance and angular accuracy. At the same time, it does not independently provide a full mucosal record and therefore usually requires an additional intraoral scan or conventional impression followed by data merging. For that reason, photogrammetry is best understood as a highly accurate component within a combined workflow rather than as a total replacement for the entire impression protocol.

Reverse scan body workflows represent a hybrid strategy intended to strengthen a fully digital approach. They may reduce intermediate steps and simplify restorative transfer through a provisional prosthesis or its digital analogue. Nevertheless, their main limitation is operator dependence. Current data suggest that reverse scan body protocols can perform well under controlled conditions, but they remain technique-sensitive and should not be treated as universally reliable without experience and calibration.

Discussion

A central methodological problem in this field is that reported outcomes are not interchangeable. Linear deviation in millimeters, interimplant discrepancy in micrometers, angular error in degrees, and final framework misfit describe different phenomena. Comparing them directly can lead to false conclusions. From a clinical perspective, the decision should therefore be risk-based rather than ideological. Conventional impressions remain preferable when anatomy is unfavorable, distal implant angulation is challenging, landmarks are poor, or tolerance for prosthetic misfit is minimal. Intraoral scanning is justified when conditions are controlled and efficiency, patient comfort, and digital workflow integration are major priorities. Photogrammetry

is especially useful when highly accurate implant-position capture is needed within a combined digital protocol. Reverse scan body methods may be effective in experienced hands, but clinical verification of fit remains mandatory before definitive delivery.

Limitations

This synthesis is narrative rather than systematic. The included literature was selected for thematic and clinical relevance, not through a registered PRISMA-based protocol. In addition, the available evidence remains heterogeneous in hardware, software, operator experience, and endpoint reporting. Many favorable digital findings originate from in vitro or highly standardized conditions and therefore should not be generalized uncritically to routine clinical practice.

Conclusions

1. Current evidence does not justify treating a fully digital workflow as a universal solution for every All-on-X case.
2. Conventional impressions still provide an important safety margin when maximum trueness is required.
3. Intraoral scanning improves comfort and efficiency, but its accuracy in complete edentulism remains condition-sensitive.
4. Photogrammetry is highly promising for implant-position capture, yet it still depends on additional soft-tissue registration.
5. Reverse scan body workflows are promising hybrid options, but they are operator-dependent and require strict verification.

Selected References

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