

STATIC VS. DYNAMIC NAVIGATION IN GUIDED ENDODONTICS

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INTRODUCTION

Digitalization of operative procedures through three-dimensional (3D) navigation is a remarkable advancement in the field of dentistry which allows both precision and accuracy while treating patients. It is an emerging technology with a wide variety of applications in dentistry. Guided endodontics is a novel approach used in the management of calcified root canals, autotransplantation and periradicular surgery. Cone beam computed tomography (CBCT) devices and software, associated with digital planning and 3D printing resources, allowed the advent of guided endodontics. There are two types of guided endodontics - static guided endodontics and dynamic guided endodontics.

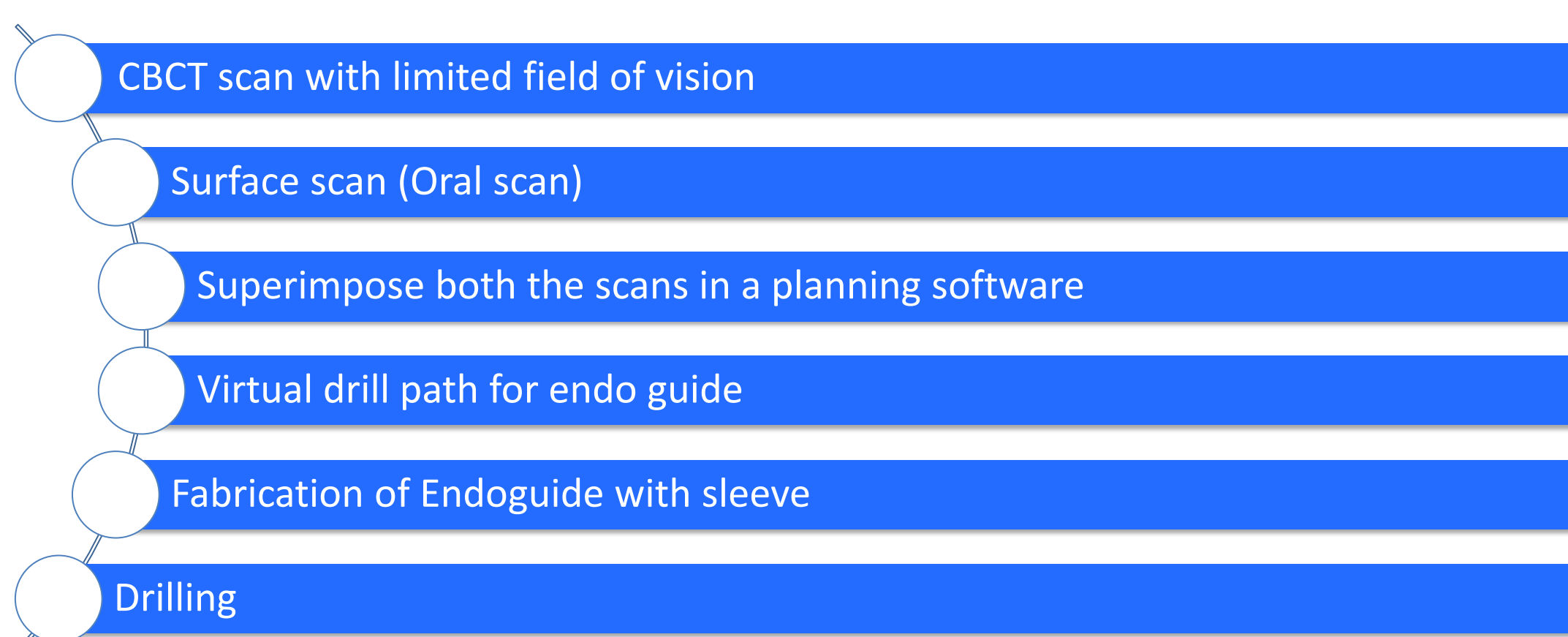
STATIC NAVIGATION

Static navigation system uses a template, a 3D endodontic guide or endoguide to drill in predetermined positions for locating and exploring root canal orifices or bone trephination and root end resection. Static navigation helps to reduce excessive loss of tooth structure and chair-side operating times, provides more precise incisions, both in gum and bone tissues, accurate root resection, and better postoperative healing. In addition, the treatments based on this approach are less time consuming in comparison to free-hand techniques. Furthermore, using a single bur or two burs ensures the accuracy of the drilling procedure.

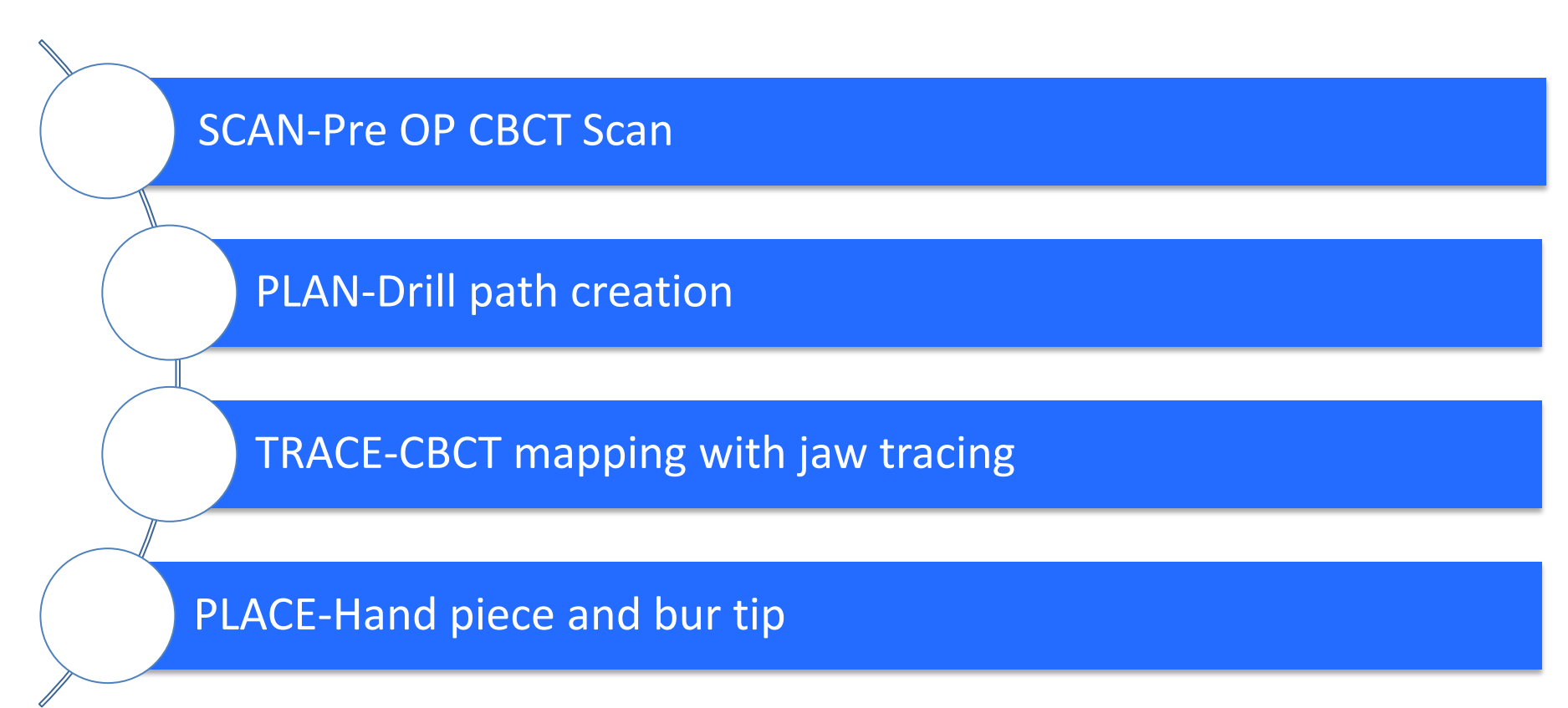
DYNAMIC NAVIGATION

Dynamic navigation system is a computer-aided guided technology which provides real-time feedback to the clinician regarding the drill path during treatment with the help of multiple cameras and motion tracking devices attached to the dental hand piece and patient. The most common analogy used for computer-aided dynamic navigation is the GPS-tracking system (Global Positioning System). Dynamic navigation system should be considered in cases of increased complexity as they facilitate the treatment and reduce the risk of iatrogenic errors. Currently, there are four different dynamic navigation systems available for endodontic use - Navident, X-guide, ImplaNav and Denacam.

STATIC NAVIGATION WORKFLOW



DYNAMIC NAVIGATION WORKFLOW



Device required: Straumann drill, SS White Endo bur, Muncie bur, slow speed hand piece, standard armamentarium for RCT/ surgery

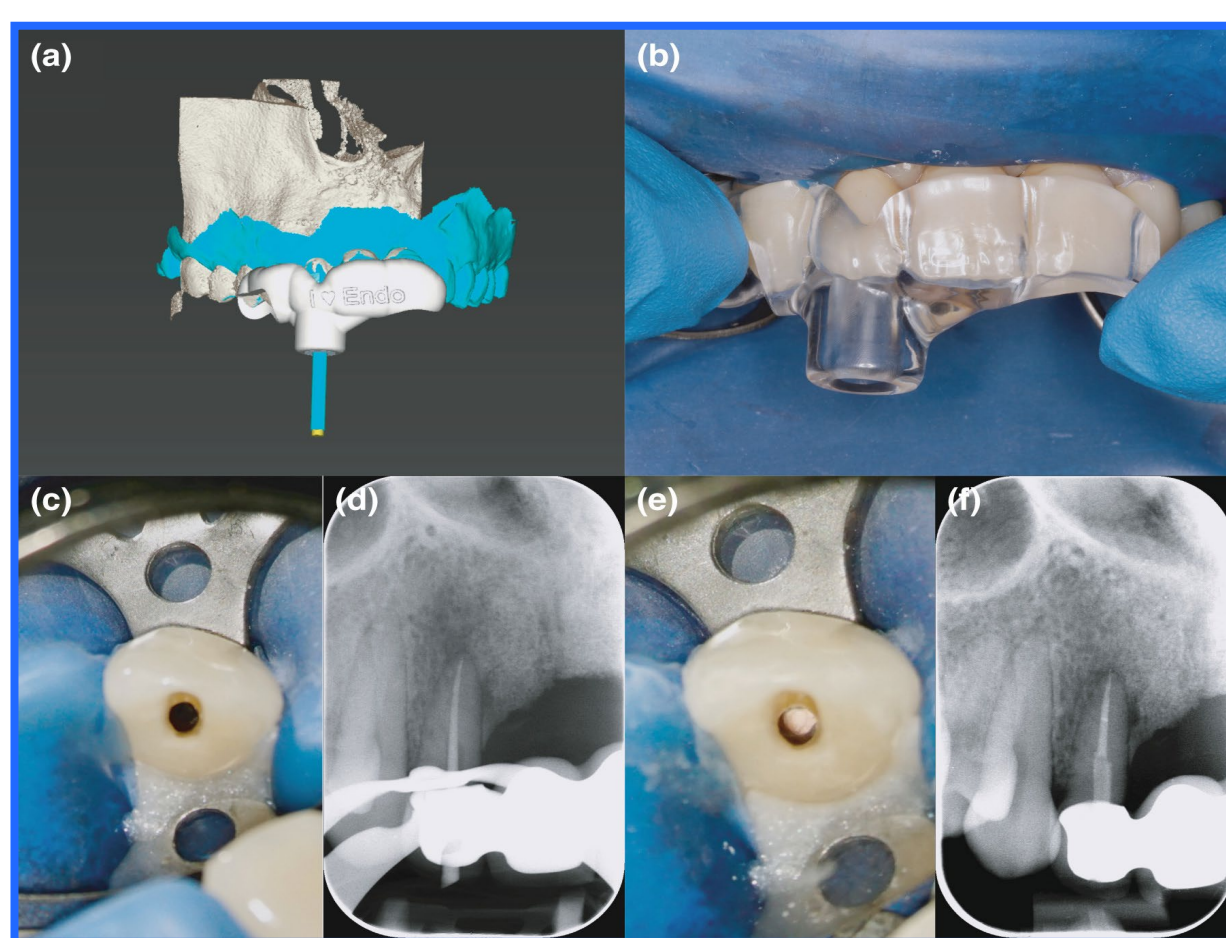
Pre operative requirements: CBCT, Oral scan /diagnostic impression

Operators accessibility: Limited and not possible to modify treatment plan once guide is fabricated

STATIC NAVIGATION

Advantages: Accurate reproduction of details, print complex geometric shapes, less time for treatment.

Disadvantages: Expensive, allows only linear access, stent may not be stable in partially edentulous patient



Device required: Hand piece attachment, patient jaw attachment, stereoscopic camera, computer with navigation camera, fiducial marker

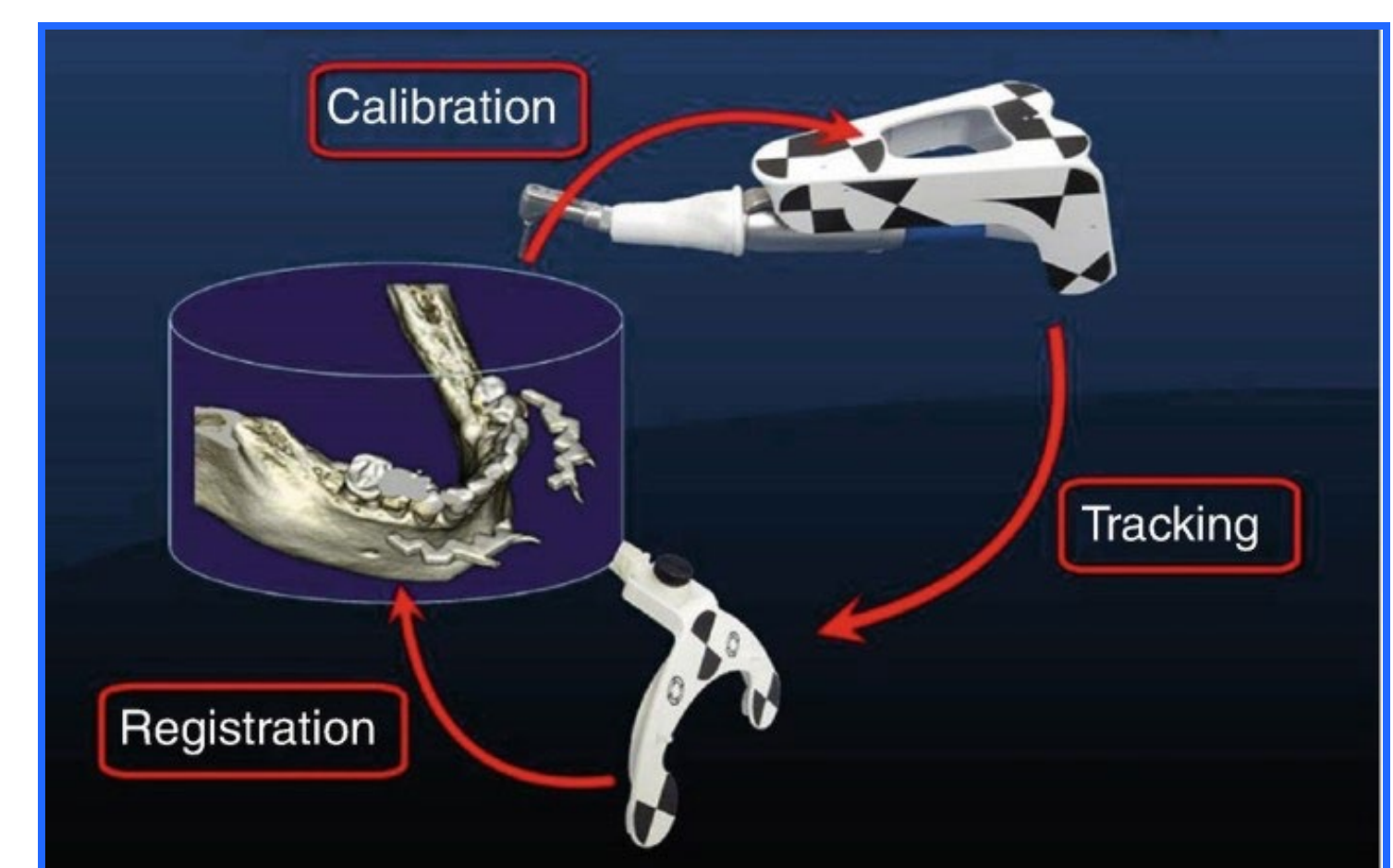
Pre operative requirements: CBCT

Operators accessibility: Good and possible to modify the procedure plan at any time of treatment.

DYNAMIC NAVIGATION

Disadvantages: Learning curve, longer surgical time, initial cost of setting up of equipment

Advantages: Effortless and superior in accuracy, real time calibration, useful in multi rooted tooth.



DISCUSSION & CONCLUSION

The guided access procedure and virtual planning can significantly reduce access cavity size, preserve the tooth structure, and avoid accidents such as deviations or perforations. Guided endodontics applications encompass not only endodontic cavity access and canal location with pulp obliteration but can also be applied in cases of osteotomy and apicoectomy as well as retrograde fillings, removal of fiberglass posts, and treating teeth with morphological asymmetries. Static guided endodontic technique is independent of the operator's experience, requires less treatment time for the patient, and is more accurate and safer than conventional endodontics. Dynamic guided navigation technique is more ergonomic, and it allows for the real-time adjustment and repositioning of the working instruments. It is more accurate as it does not accumulate design errors, and it is useful in cases of multi-rooted teeth. Guided endodontics using static or dynamic navigation appears to be a safe and minimally invasive method. Dynamic navigation, in particular, still has great potential for further development.

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