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Lecture notes:

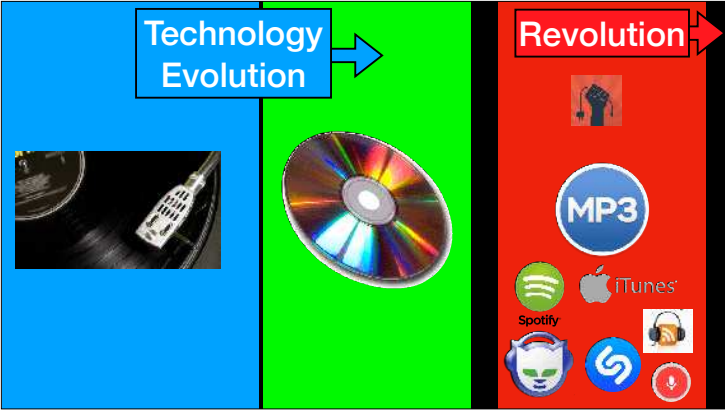
## Computer Assisted Implant Surgery: Static, dynamic or robotic?

- The role of CAIS in the Integrated Digital Workflow
- Static, Dynamic and Robotic
- Accuracy, Clinical Outcomes and PROMs
- Technology and future

Based on the presentations in Foz do Iguacu, Bogota and Lima in October/November 2022. The content of these notes is not self-explanatory and is not intended as an independent learning resource but rather a supplement to attending the seminars.







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A group of six medical professionals in green scrubs and blue hairnets are standing in a hallway. In the background, there is a sign that reads 'เมื่อไหร่ที่คุณเปิด' and 'When you open the door'.

**CAIS:**

Precision / accuracy
Utility / Cost effectiveness
Patient Related Outcomes
Indication / contra indication
immediacy / early / delayed

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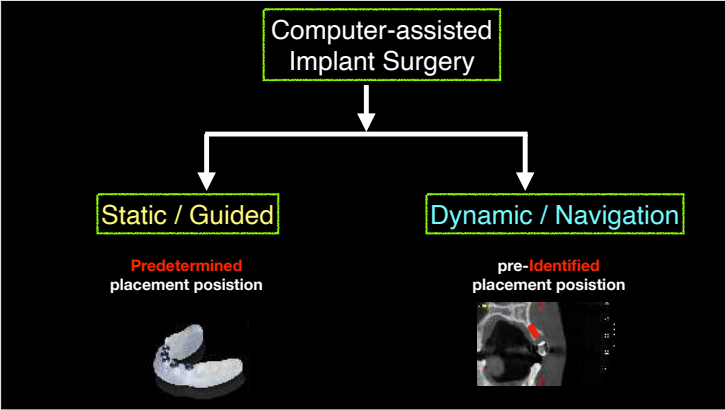
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STATIC CAIS SYSTEM FEATURES										
Locking	self-locking			no self-locking						
Guidance System										
	sleeve in sleeve			mounted sleeve-on-drill			integrated sleeve-on-drill			
Sleeves	no sleeves (acrylic)			Titanium sleeves			Zirconia sleeves			
Guide Design	teeth supported			mucosa supported			bone supported (fixation)			hybrid
	full coverage			partial coverage			stackable (implants + ostectomy)			
Production	3D printed (acrylic)			milled (PMMA)						
Planning Software	CoDiagnostix	Nobel Clinician	BlueSky Bio	Implant Studio	Exocad	Romexis	3D Stendcad	6D Planning		
Software	Simplant	3Diagnosys	R2Gate	Ondemnad 3D	Realguide	SMOP	Smileplan	Galimplant	Implant Viewer	

## Static / Guided

### Workflow accuracy:

Minimum (%)	Maximum (%)	Mean (%)	SD
-18.19	21.00	-2.25	11.84
-16.91	31.68	-5.49	18.36
-23.82	25.29	-1.24	13.93
-26.22	19.00	-1.93	13.29
-28.90	9.34	-3.66	9.71
-22.15	17.61	-4.47	13.35
-19.35	13.38	-2.47	10.97
-23.62	9.64	-3.69	9.16
-18.94	18.56	-1.85	10.59
-31.25	23.46	-3.67	13.62
-26.82	22.61	-3.86	15.20
-26.39	39.76	-2.25	12.85

Linear: 3-4.8% (max 0.6mm)

Volumetric: 1.6-4.4 %

Pimentel et al 2015 J Med Engin & Tech  
Park et al 2017 Imag Sci Dent

CBCT & planing

## Static / Guided

### Workflow accuracy:



CBCT & planing

Guide

- fit

- elasticity

- tolerance

- design

## Static / Guided

### Workflow accuracy:



CBCT & planing

Guide

- fit

- elasticity

- tolerance

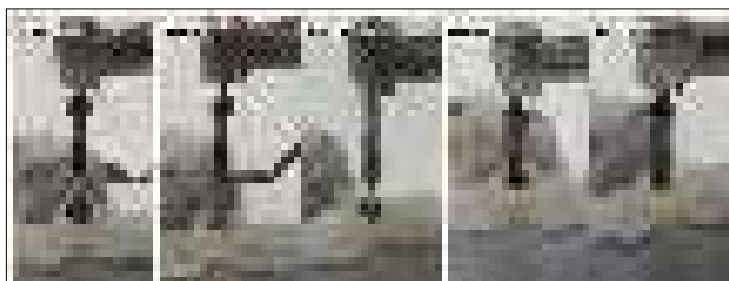
- design

## Static / Guided

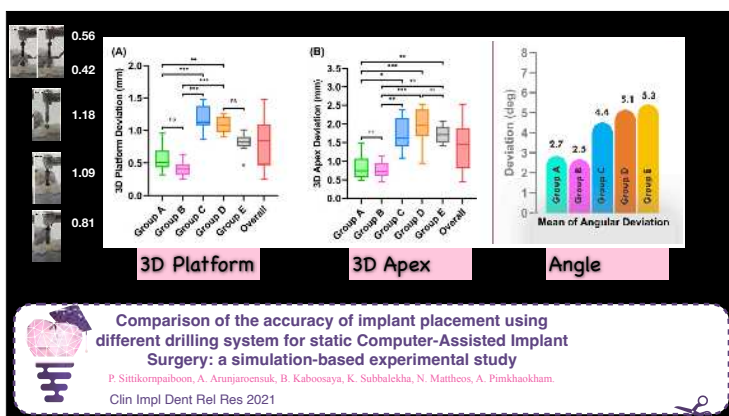


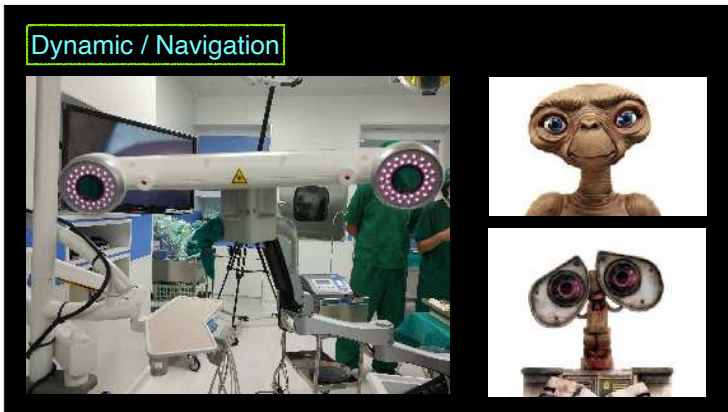
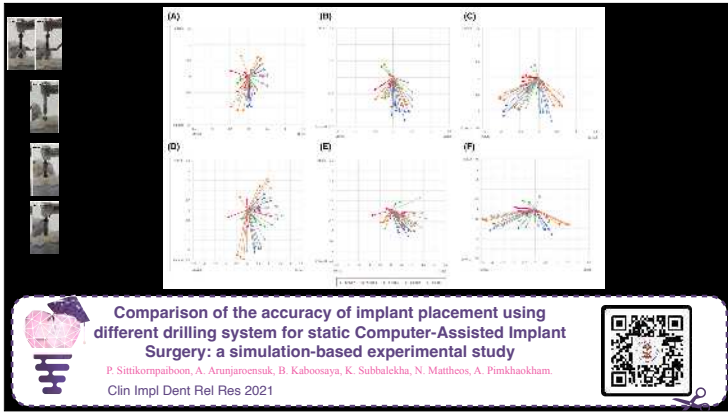
## Workflow accuracy:

- CBCT & planing
- Guide
- fit
- elasticity
- tolerance
- design
- osteotomy drills & sequence



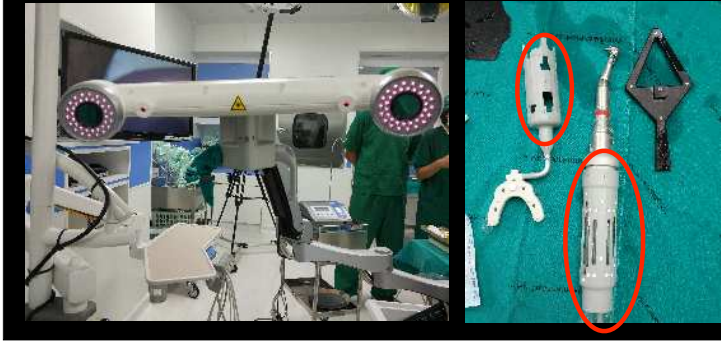
**Comparison of the accuracy of implant placement using different drilling system for static Computer-Assisted Implant Surgery: a simulation-based experimental study**  
P. Sittikornpaiboon, A. Arunjaroenrak, B. Kabosaya, K. Subbalekha, N. Mattheos, A. Pimkhakham  
Clin Impl Dent Rel Res 2021



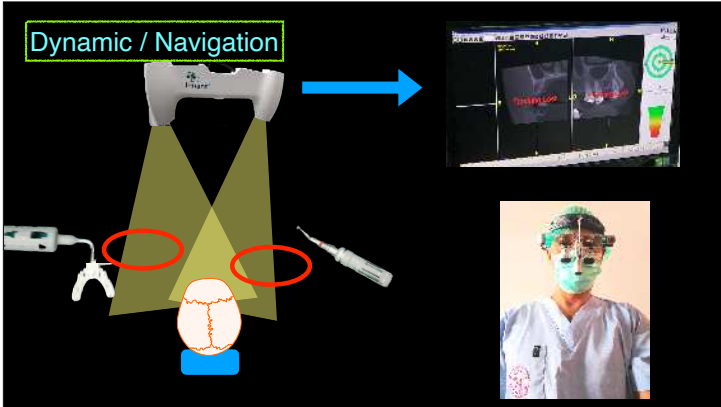




## Dynamic / Navigation



## Dynamic / Navigation







	Conventional Freehand			Dynamic Navigation			Static Guided		
	single	partial	edentulous	single	partial	edentulous	single	partial	edentulous
Accuracy	++	+	+-	++	++	++	++	++	++
	1.3 (0.7)		3.4 (2)	1 (0.4)	1.24 (0.3)	1.7 (0.4)	0.9 (0.8)	1.04 (0.6)	1.4 (0.7)
	2.2 (1.2)		3.6 (2)	1.2 (0.5)	1.5 (0.5)	1.8 (0.4)	1.2 (0.9)	1.5 (0.7)	1.6 (0.7)
	7 (7)		10 (4.9)	3 (1.3)	3.7 (1.8)	5.7 (2)	2.8 (2.6)	4 (1.6)	4.9 (2.1)

Kiatkroekkrai et al, IJOMS 2019    Sittikompaiboon et al, CIDRR 2021  
 Smitkarn et al, JCP 2019    Engkawong et al, CIDRR 2021  
 Kaewsiri et al, COIR 2019    Jaemsuwan et al, IJOMS 2022  
 Yimarj et al, CIDRR 2020

	Conventional Freehand	Dynamic Navigation	Static Guided
Clinical Outcomes	<b>✓ No difference:</b> Osseointegration Survival post-op complications intraoperative complications long-term complications	<b>✓ Some difference:</b> Aesthetic Outcomes time / efficiency insertion torque learning curve <b>✓ Potential:</b> flapless surgery immediacy restorative driven	

Can computer-assisted implant surgery improve clinical outcomes and reduce the frequency and intensity of complications in implant dentistry?  
 Pimkhaokham et al Periodontology 2000, Oct 2022

Conventional Freehand
Dynamic Navigation
Static Guided

PROs

PRE

✓ Strong difference:

presurgical preference

✓ No difference:

post-op healing

Painkiller consumption

Time (days)

Conventional

Dynamic

Static

Can computer-assisted implant surgery improve clinical outcomes and reduce the frequency and intensity of complications in implant dentistry?

Pimkhakham et al Periodontology 2000, Oct 2022

Conventional Freehand
Dynamic Navigation
Static Guided

PROs

PRE

✓ Strong difference:

presurgical preference

✓ No difference:

post-op healing

✓ "game changer"

flapless surgery

Pain scores

Time (days)

Conventional

Dynamic

Static

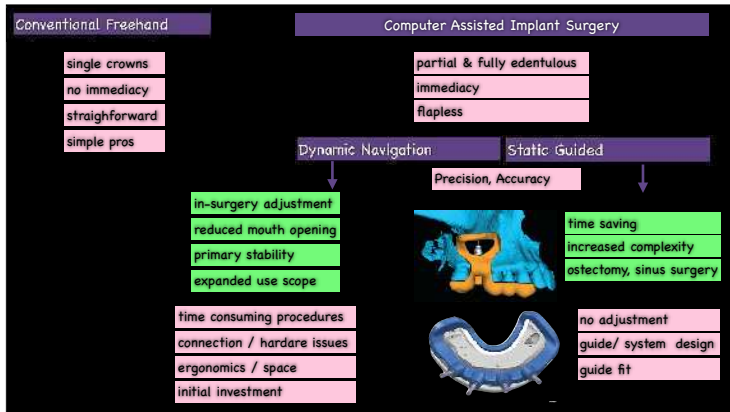
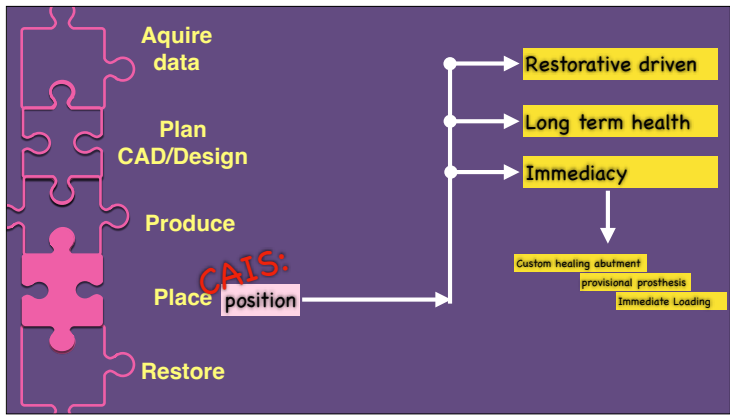
Can computer-assisted implant surgery improve clinical outcomes and reduce the frequency and intensity of complications in implant dentistry?

Pimkhakham et al Periodontology 2000, Oct 2022

Anterior

Full Arch

Posterior



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