

Implementácia modulovaného elektrónového bolusu MEB

Ivana Kinclová, Gabriel Králik, Miloslav Kulich, Olha Myronchyk,
Veronika Oravczová, Marek Paluga, Kristína Šavrtková



Vyhlásenie o konflikte záujmov autora

- ☒ Nemám potenciálny konflikt záujmov
- ☐ Deklarujem nasledujúci konflikt záujmov

Forma finančného prepojenia	Spoločnosť
Participácia na klinických štúdiách/firemnom grante	
Nepenažné plnenie (v zmysle zákona)	
Prednášajúci	
Akcionár	
Konzultant/odborný poradca	
Ostatné príjmy (špecifikovať)	

Motivácia

- Modulované pole elektrónového zväzku
- Využitie vybavenia (systém s 3D tlačou a softvérom pre prípravu adaptívnych bolusov)
- Spustenie procesu implementácie MEB
 - Preskúmanie možností využitia
 - Nájdenie limitov (hrúbka bolusu, hĺbka ciev pod povrchom...)
 - Výber scenárov optimálneho využitia
 - Získanie skúseností a zručností v technológii prípravy liečby

3D tlač - vhodný nástroj pre prípravu MEB





- OÚSA a VOÚ už majú pomerne bohaté skúsenosti s klinickým využitím
- My zatiaľ podnikáme prvé neisté kroky
- Prvým využitím u nás je príprava foriem pre MEB

Ukážka publikací 2022-2023

A review of 3D printing utilisation in radiotherapy in the United Kingdom and Republic of Ireland

Gordon Sands^a, Catharine H. Clark^{b c d}, Conor K. McGarry^{e f}  

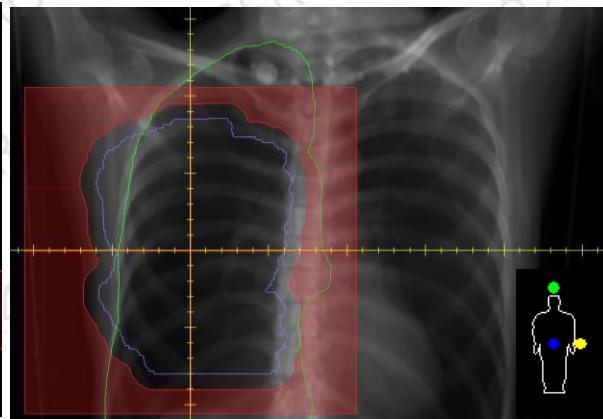
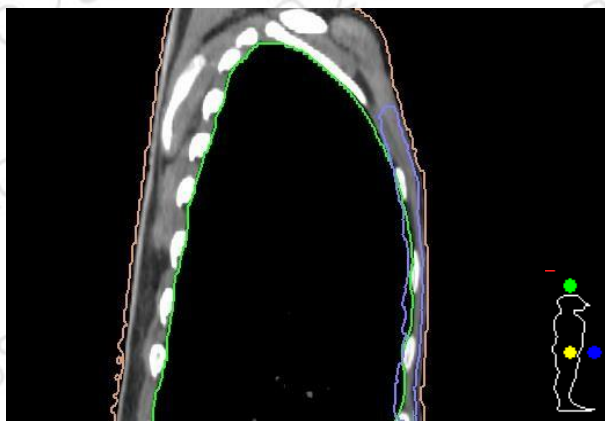
Dosimetric benefits of 3D-printed modulated electron bolus following lumpectomy and whole-breast radiotherapy for left breast cancer

Venus W.Y. Lee Mphil^{*}  , Alex C.H. Liu MMedSc[†], Ken W. Cheng MMedSc^{*}, Chi-Leung Chiang MBChB^{‡ §}, Victor Ho-Fun Lee MD^{‡ §}  

Feasibility of a Patient-Specific Bolus Using the Life-Casting Method for Radiation Therapy

by **Jeongho Kim**¹ , **Jeehoon Park**¹ , **Beomjun Park**^{2,3,4}  , **Byungdo Park**^{1,*†}   and **Tae-Gyu Kim**^{1,*†}  

Hypotetický příklad

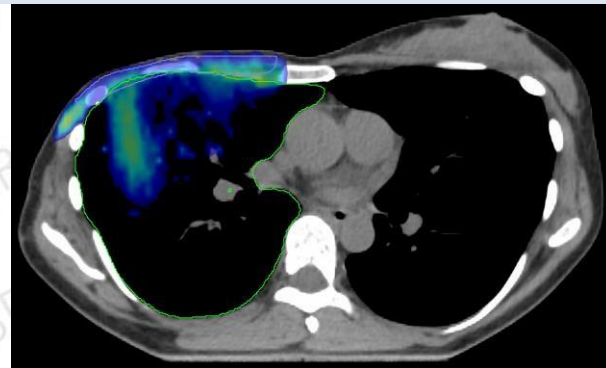
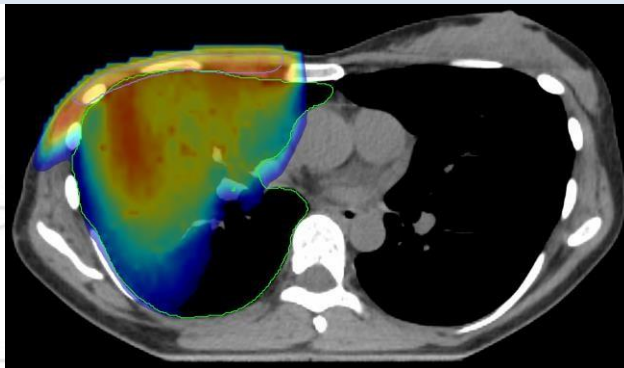
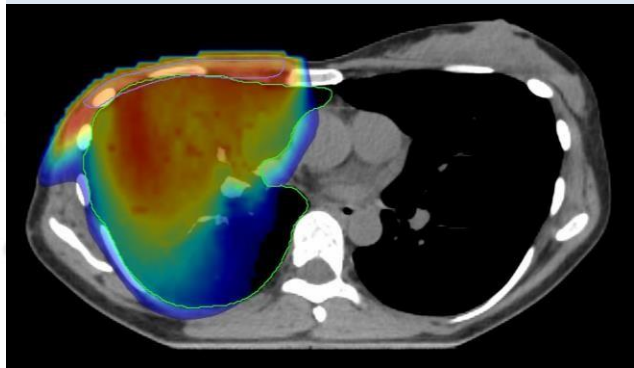


izodóza 30%

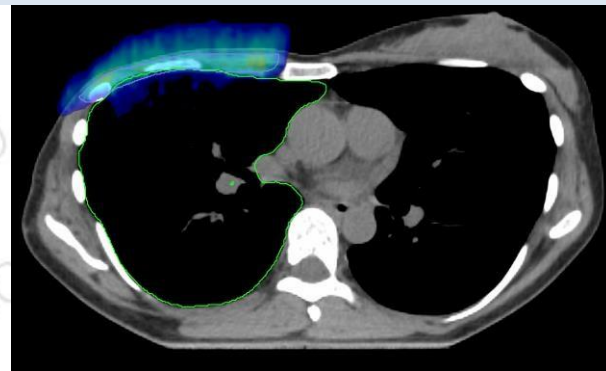
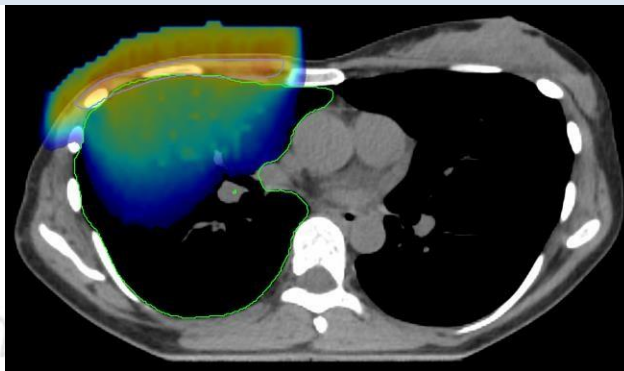
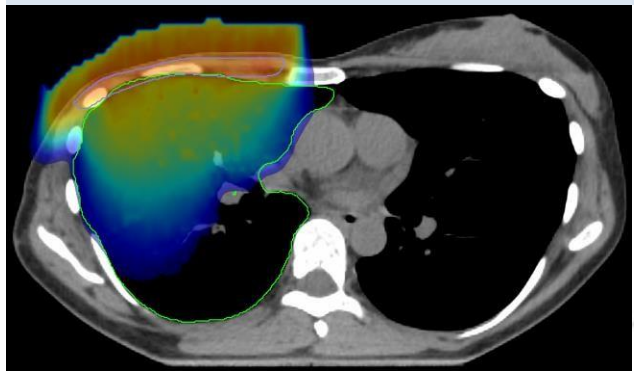
izodóza 50%

izodóza 90%

bez bolusu



s bolusom

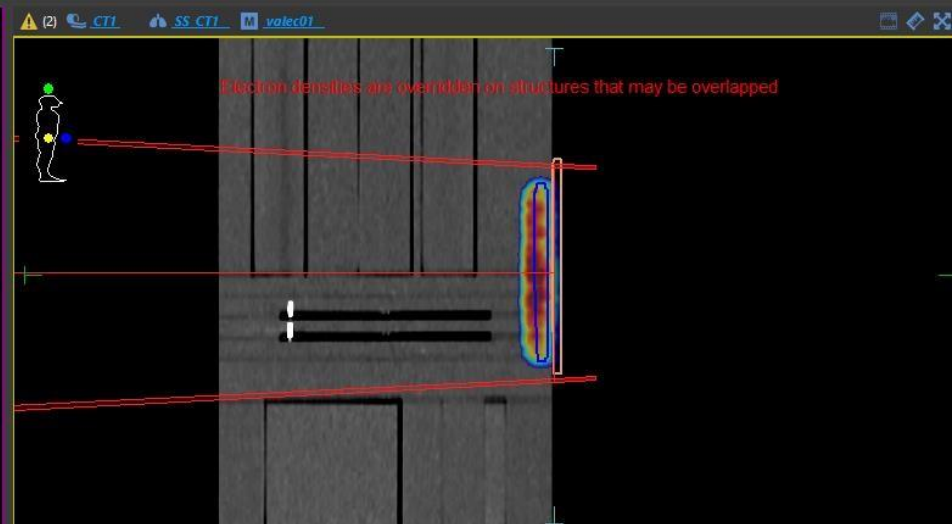
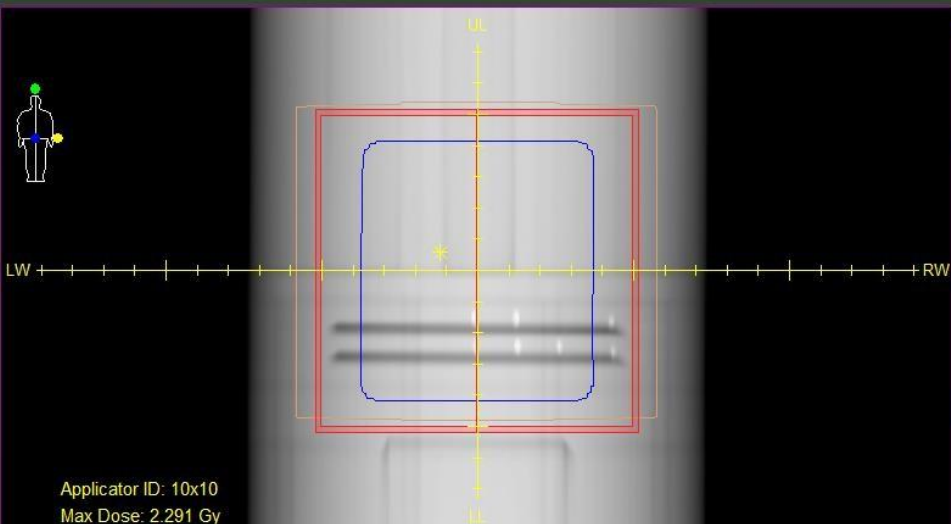
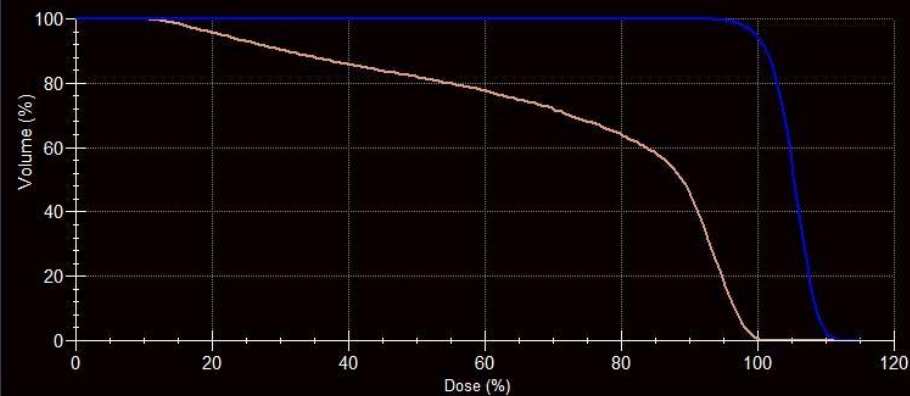


Postup prípravy MEB

- Nemodulovaný (uniformný) bolus napr.5mm
- Iteratívne formovanie bolusu (v TPS a v špeciálnom programe) tak aby okraj 90% izodózy čínejšie kopíroval PTV
 - CT, štruktúry (bolus, PTV, izodóza, body)
- Finálne formovanie bolusu za účelom odstránenia maxim

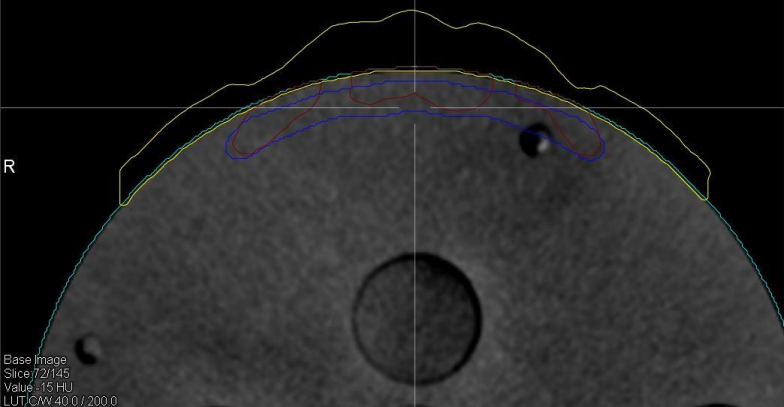
Electron densities are overridden on structures that may be overlapped

Density overrides used in Monaco calculation / Monte Carlo dose at single point may be several standard deviations from true dose. Beam weights should be based on global results, such as isodoses and DVHs. / Electron densities are overridden on structures that may be overlapped



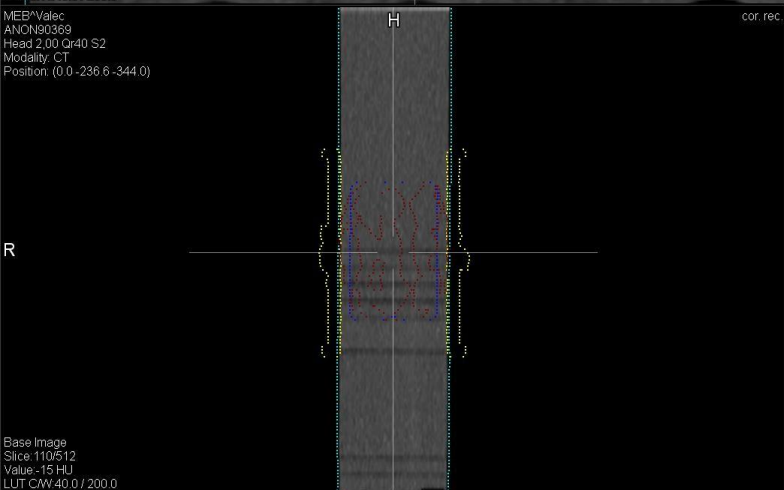


MEB^Valec
ANON90369
Head 2.00 Qr40 S2
Modality: CT
Position: (0.0 -236.6 -344.0)



Base Image
Slice: 72/145
Value: -15 HU
LUT: CW:40.0 / 200.0

MEB^Valec
ANON90369
Head 2.00 Qr40 S2
Modality: CT
Position: (0.0 -236.6 -344.0)



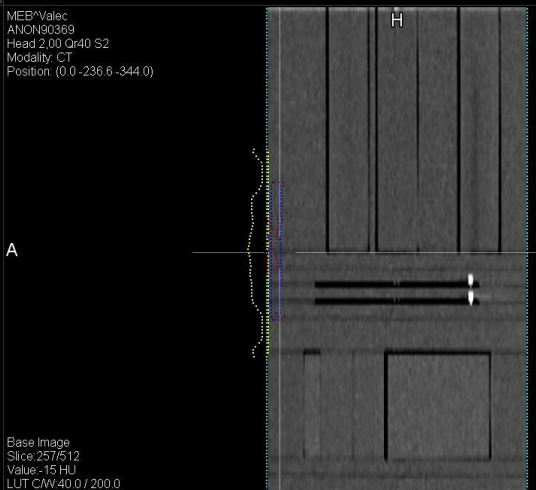
Base Image
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LUT: CW:40.0 / 200.0



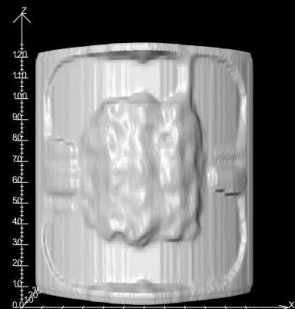
axial

cor. rec

MEB^Valec
ANON90369
Head 2.00 Qr40 S2
Modality: CT
Position: (0.0 -236.6 -344.0)



Base Image
Slice: 257/512
Value: -15 HU
LUT: CW:40.0 / 200.0



MODULATED ELECTRON BOLUS

Import

Local

Remote

Source Dir Y:/CT scans/MEB/valec

Browse

Patient Name	Label	Creation Date	Valid
MEB^Valec	01...	2024-04-19	yes

Select Structures

ME Optimization

HotSpot Correction

Bolus	ME_140524_145730
PTV	PTV
HotSpot	110.00%
Material Configuration	silicon

Bolus RED: 1.00

3D Printer: Raise 3D Pro2+

Manufacturing Process / 3D Printer Settings:
1.75 PLA

Structure Viewing

Structure	Show
110.00%	<input checked="" type="checkbox"/>
ME_140524_145730	<input checked="" type="checkbox"/>
PTV	<input checked="" type="checkbox"/>
body	<input checked="" type="checkbox"/>

☒ Show structures ☒ Fill structures ☒ Show labels
☒ Select all / none

Peak Height [%] 60

Start Optimization

Advanced Postprocessing Tools

Cropping Cropping Cropping Cropping

Export

DICOM RTSS

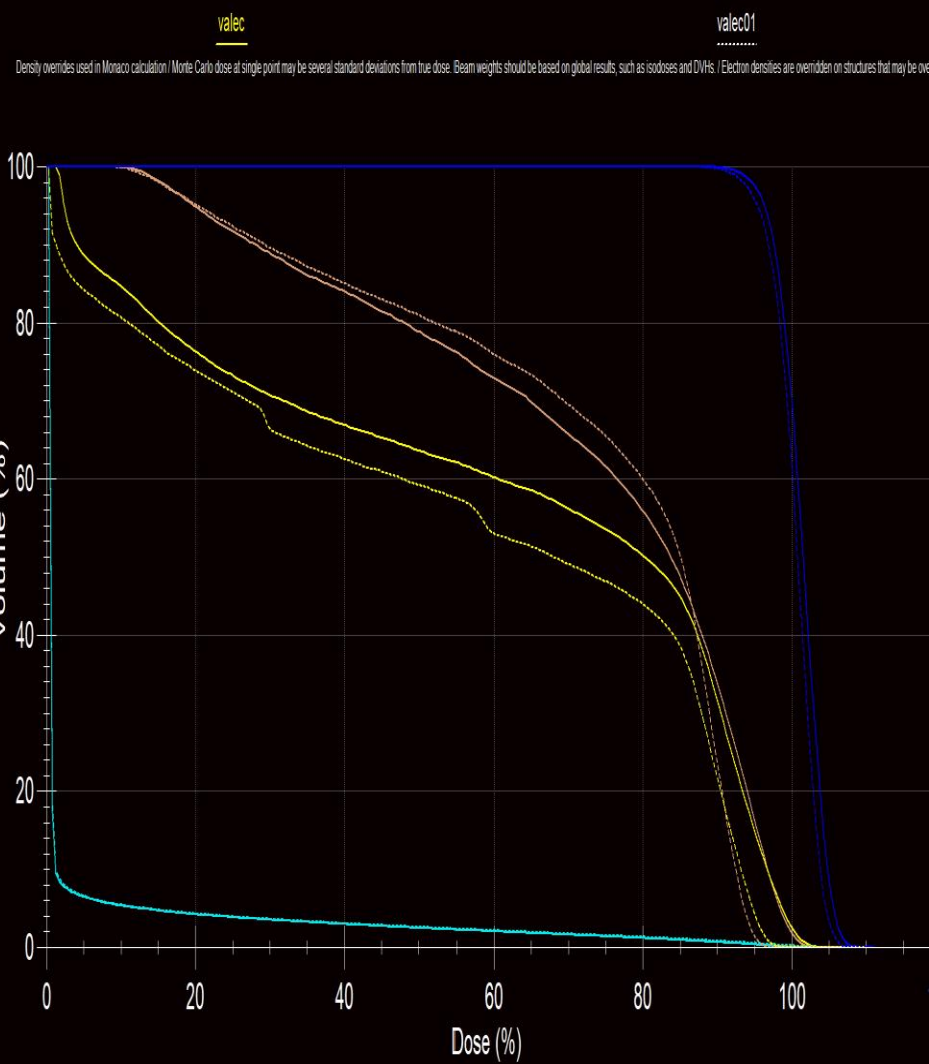
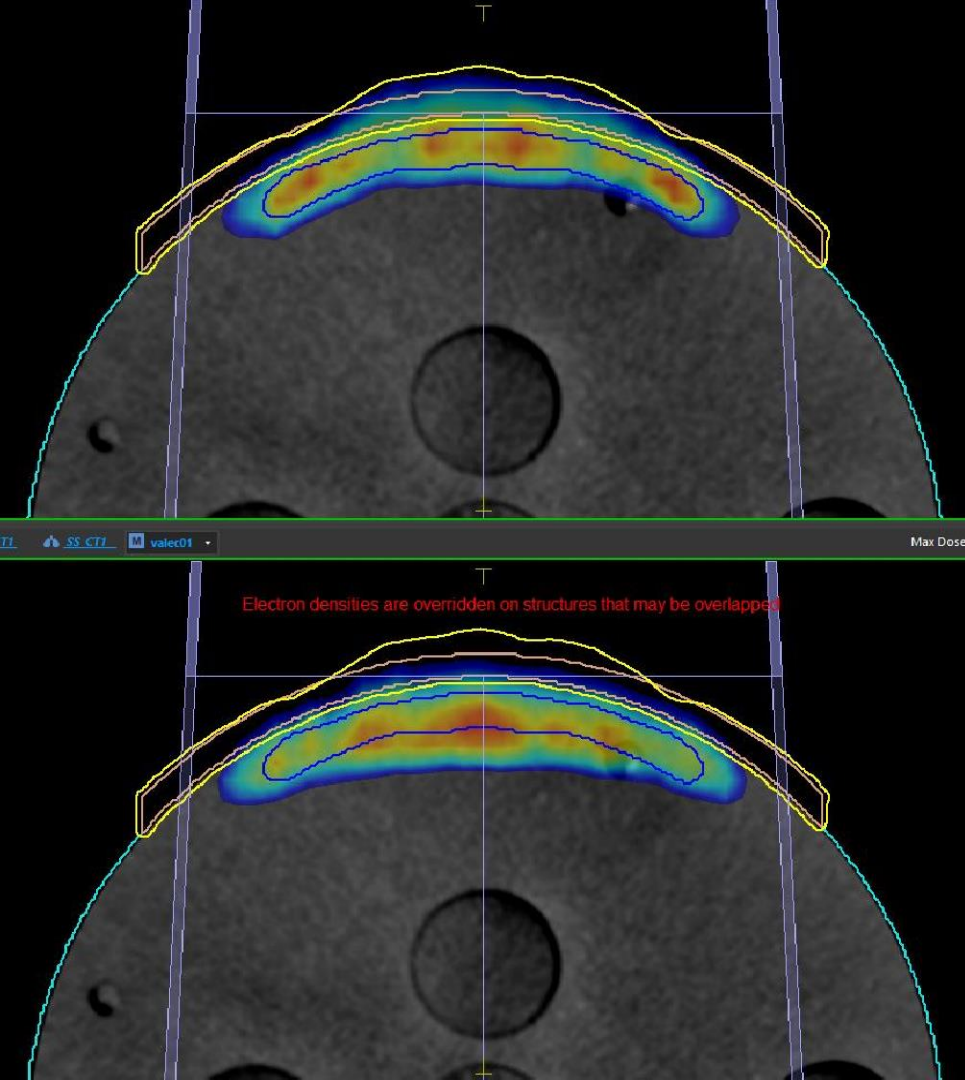
Local

PACS

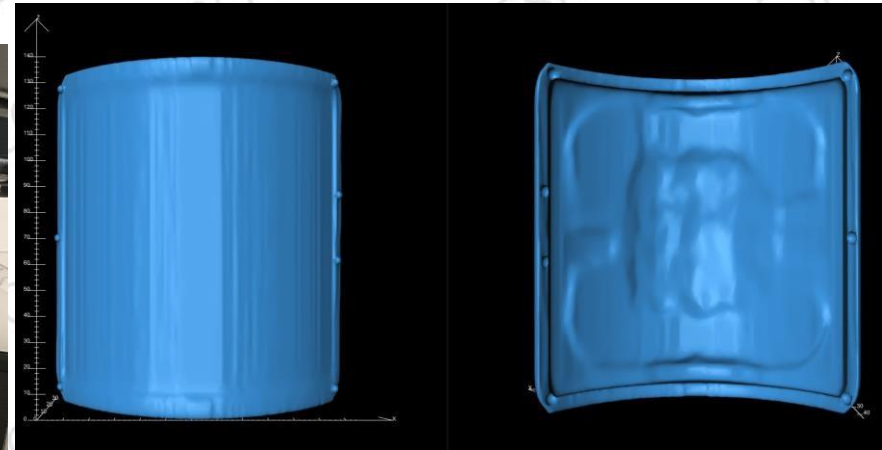
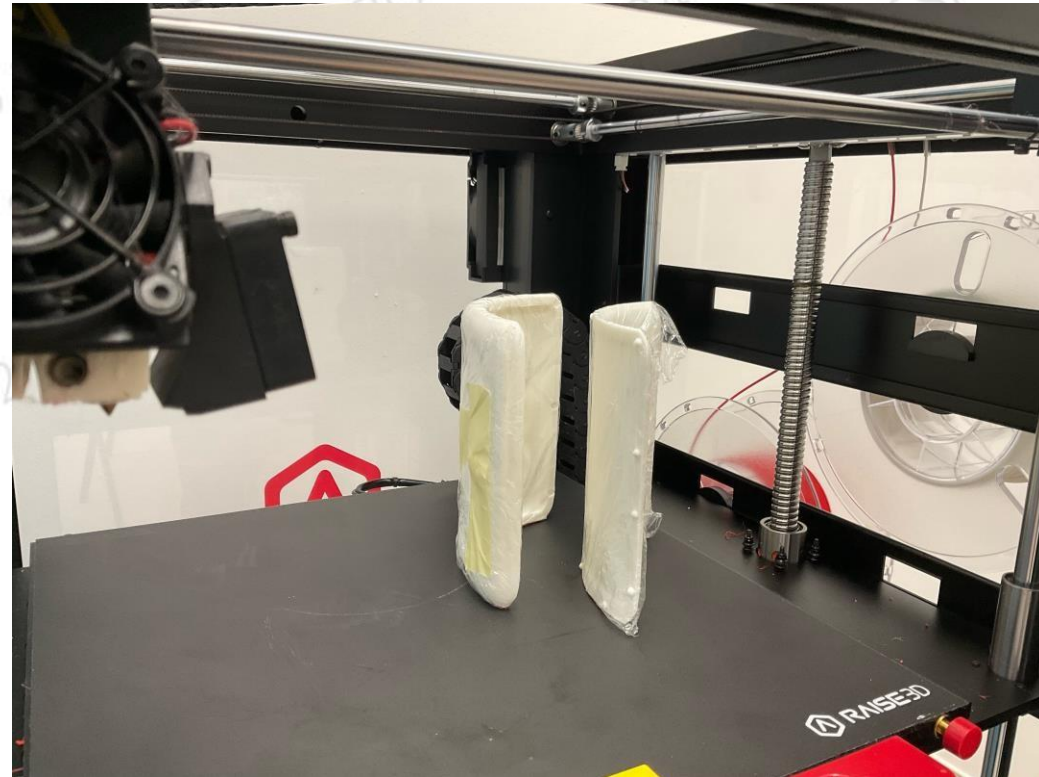
3D Print

Local

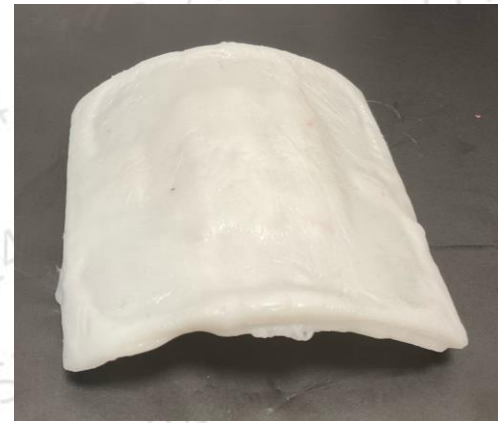
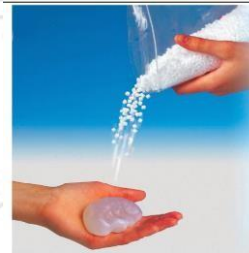
Adapt On Demand



Technológia prípravy



Thermoplastic Bolus Pellets

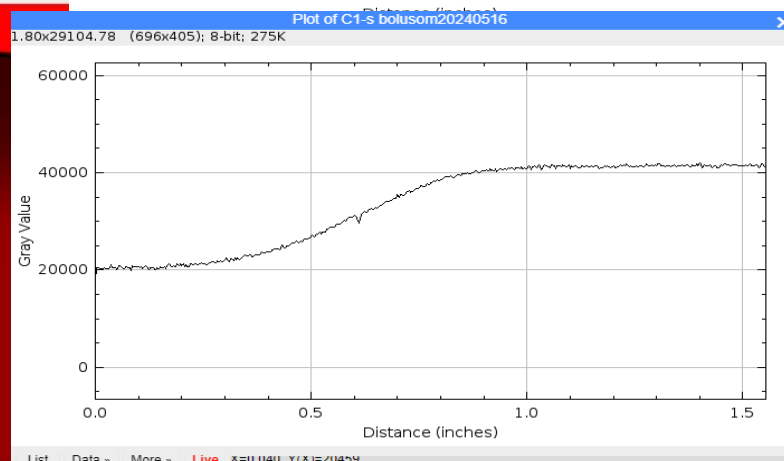
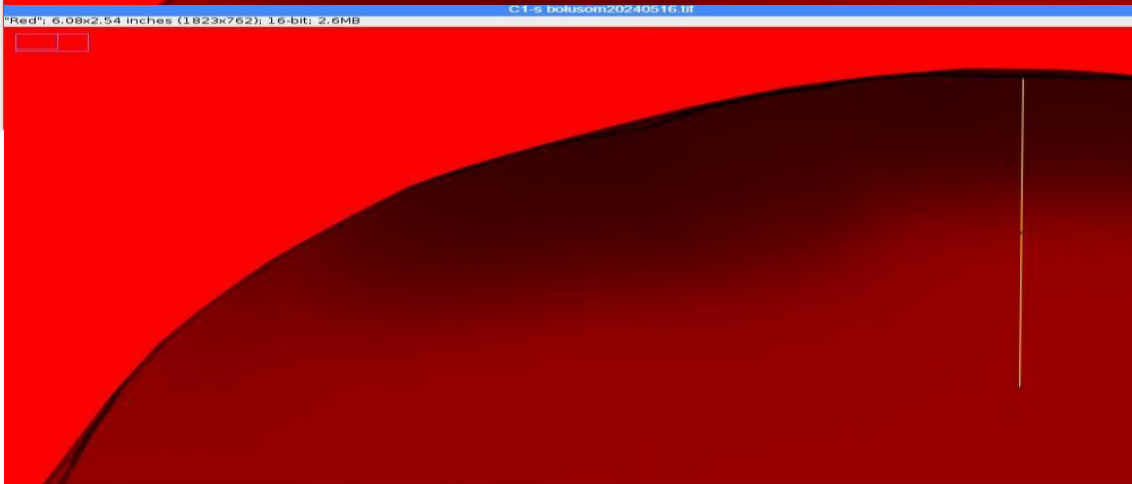
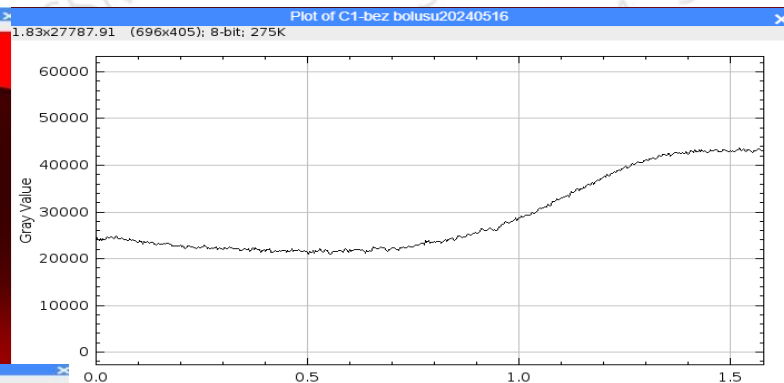
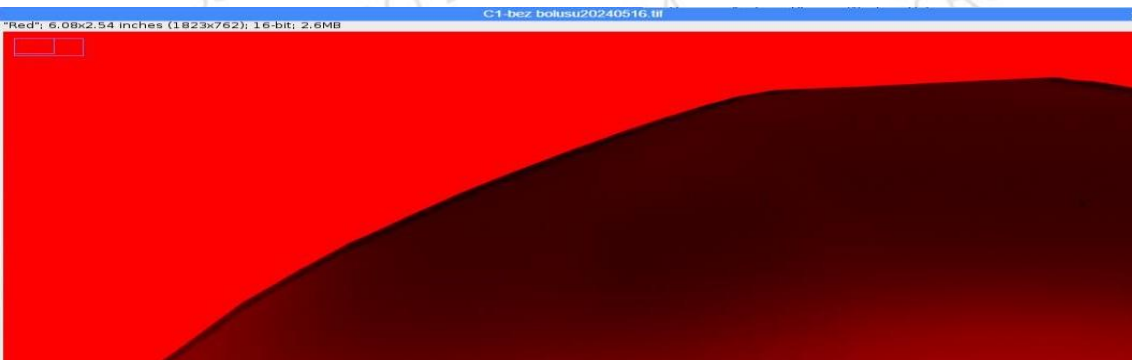




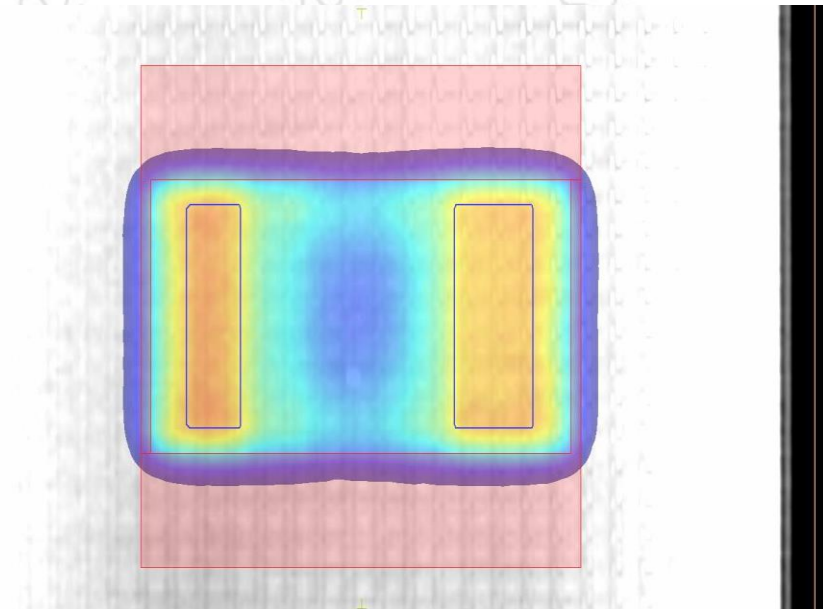
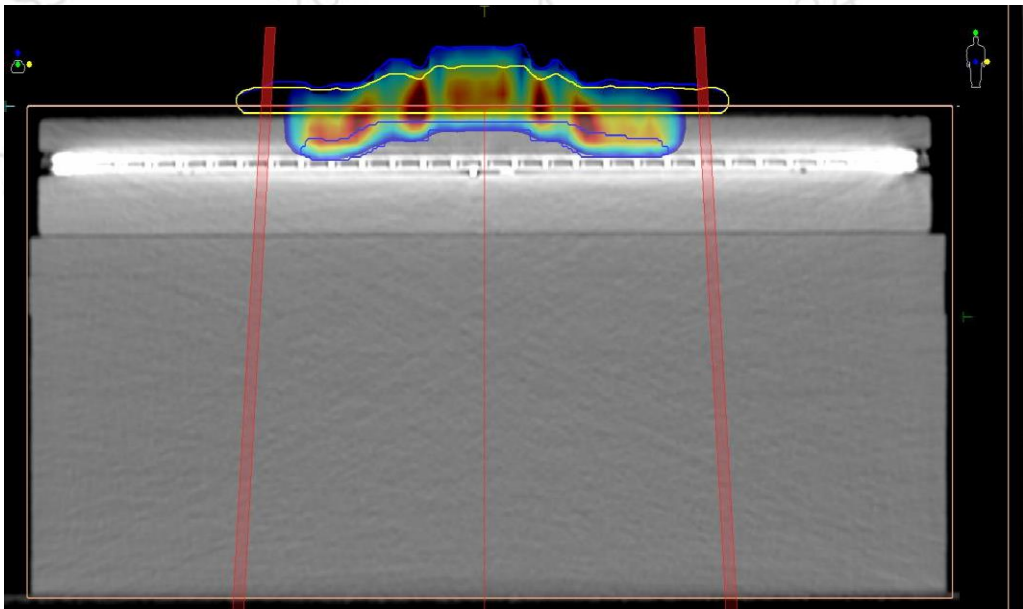
90

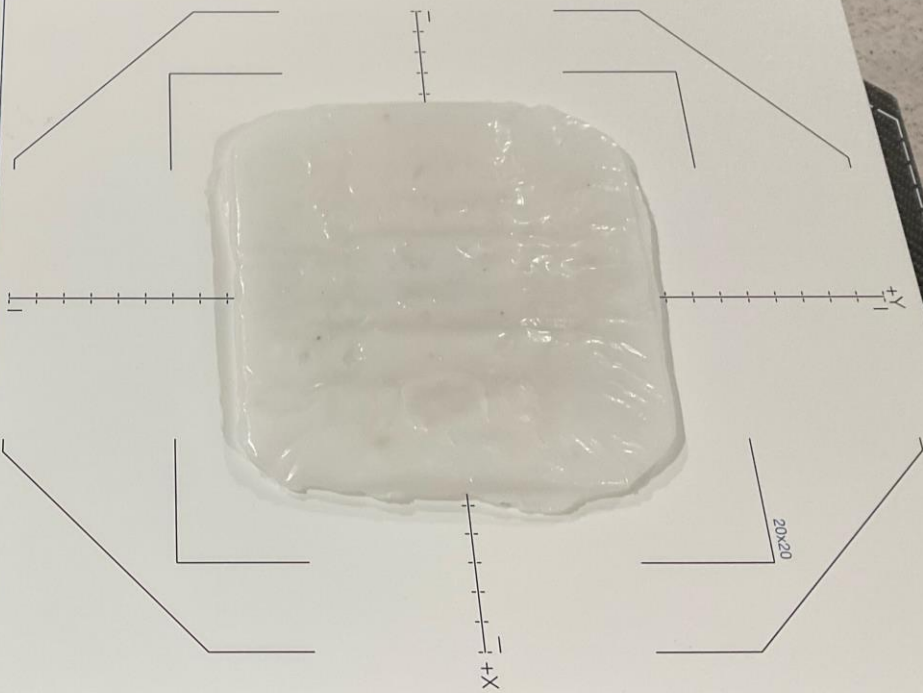
11

Valec - film - bez a s bolusom



Plánujeme overiť výpočty a RED bolusu v TPS pomocou merania s poľom detektorov





KEEP DIRECT BEAM ABOVE THIS LINE
EXPOSURE MAY VOID WARRANTY

MapCHECK[®] 3

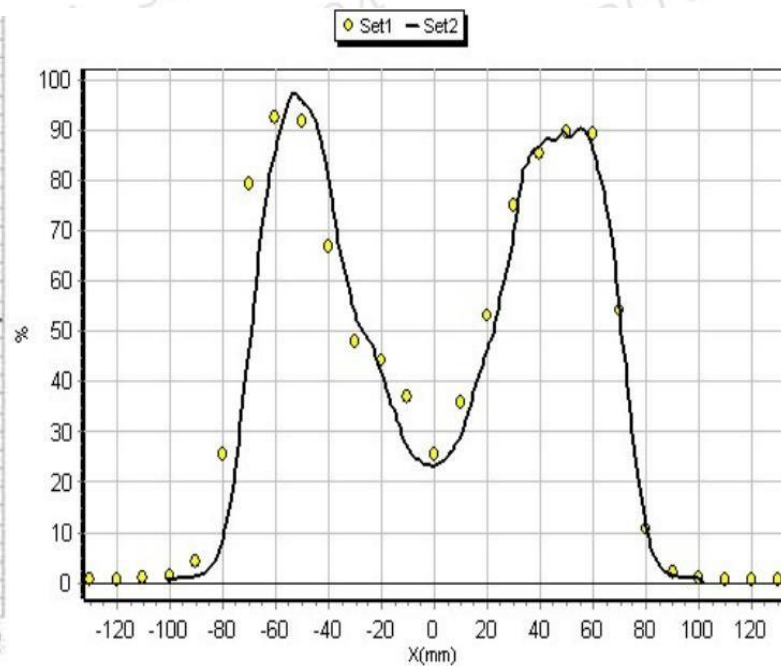
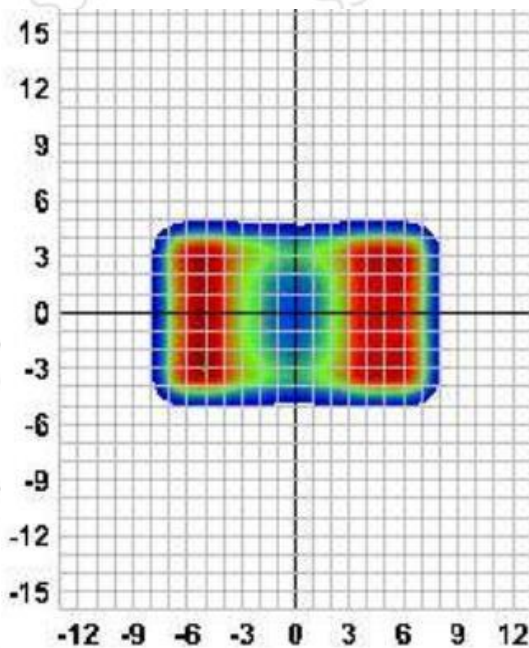
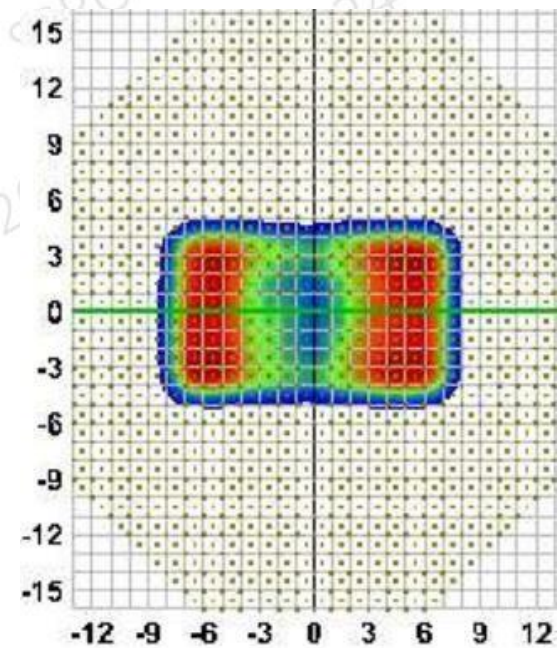


Model 1178
U.S. Patent # 125,305

Analýza výsledkov merania

meranie - Set1

výpočet - Set2



Zhrnutie na záver

- Sme na začiatku implementácie MEB
- Čaká nás ešte riešenie väčšiny zásadných výziev
- Ukázali sme:
 - jednu z možností postupu a technológie prípravy
 - 2 príklady overenia výpočtu
- Jednou z výziev a motivácií je skúmať možnosti dostatočne presného napájania elektrónových polí pomocou MEB