Comparison of four different systems for the immobilisation of the head during radiation therapy.

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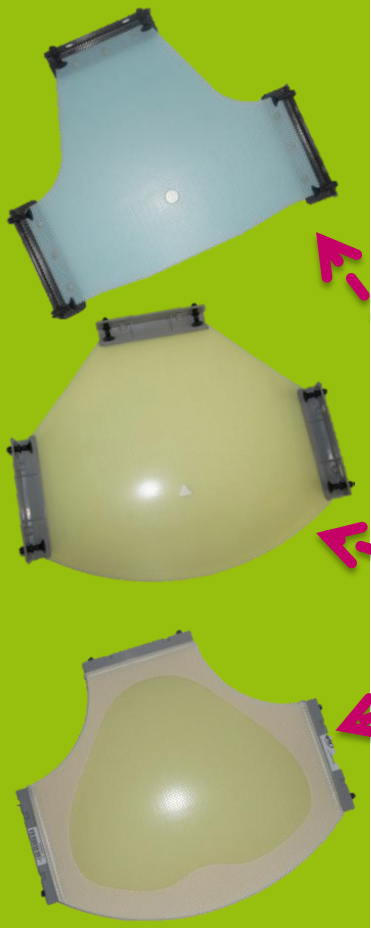
Conflict of intrest

- The authors whose names are listed certify that they have NO affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this presentation.

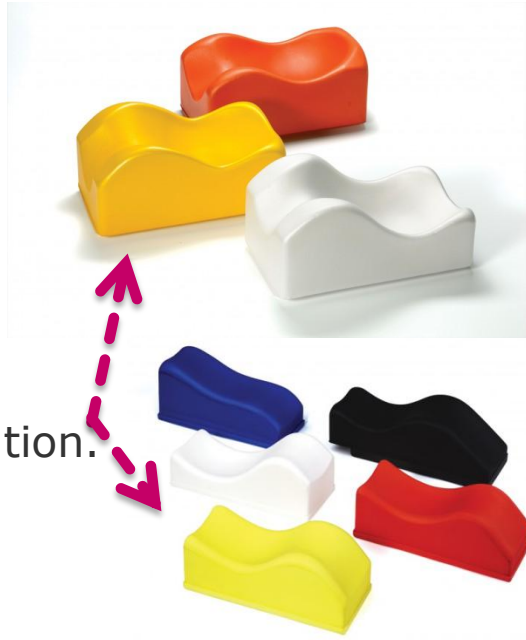
Purpose/Objective

- Daily precise reproducibility of treatment position is important for the setup margin.
- Continuous striving for high precision.
- Important factor is the setup error introduced by the immobilization system.

Purpose/Objective



- Investigate the precision of the different types of masks and head supports.
- Type of 3 points masks:
  - Posicast from Civco Medical Solution.
  - Efficast high precision from Orfit.
  - Efficast hybrid from Orfit.
- Type of Head Supports
  - Head supports from Civco Medical Solution.
  - Low Density Head Supports from Orfit.

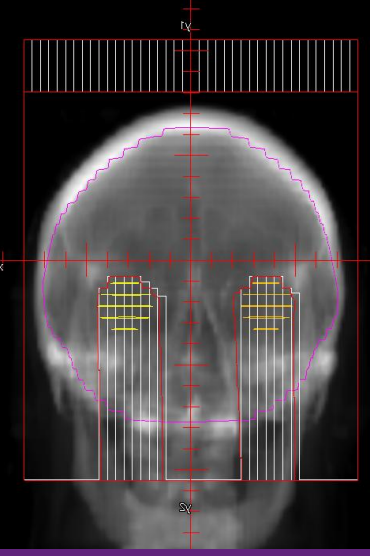


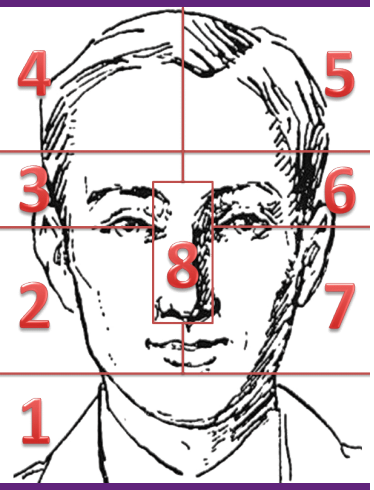
Purpose/Objective

- Patients were divided in 2 groups to determine short and long-term stability of the masks.
- Extra aim:
  - How are the different types of masks tolerated by the patients?

Materials and Methods

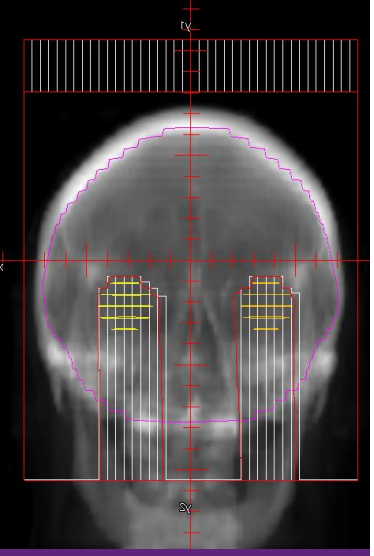
- From September 2011 until February 2013 every patient referred for radiation of the brain for at least 12 fractions was randomized to 4 categories:
  1. Posicast masks and Head supports from Civco (Standard)
  2. Efficast masks from Orfit and Head Supports from Civco
  3. Hybrid masks from Orfit and Head supports from Civco
  4. Hybrid masks and Low Density Head Supports from Orfit
- Patients receiving at least 20 fractions were randomized to one of the first 3 categories.

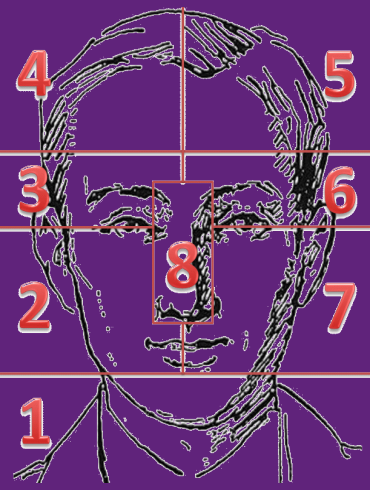




Materials and Methods

- Daily workflow:
  - Positioning patient on the treatment table based on simulation marks on the mask.
  - Electronic portal images (EPIs) of the orthogonal setup fields (0° and 90°) were made.
  - RTT's marked the straining zones on a picture of the head after treatment was done.
    - Picture of the head was split into different areas referring to the most common pressure zones.
  - RTT's asked the patient where they felt any discomfort or pressure. The RTT's marked this on a other picture of the head.





Materials and Methods

- Determing setup errors.
  - One RTT matched all the different EPI's with the DRR's for all the patients included in this study.
- Patient Comfort
  - For each pressure zone a mean overall score was calculated per patient. Score goes from :
    - 0 (no straining on any day)
    - 100 (straining each day of treatment)

Materials and Methods:

Setup margins

- For each patient the systematic and random error were calculated in order to determine the setup margins (Van Herk Formula).

$$2.5\Sigma + 0.7\sigma$$

Setup margin = 2.5 x systematic error + 0.7 x random error

- 2 Imaging protocols:
  - Daily setup correction Protocol
  - eNAL-Protocol ->
    - combination of:
      - NAL3 (No Action Level Protocol)
      - Weekly imaging protocol

Results:

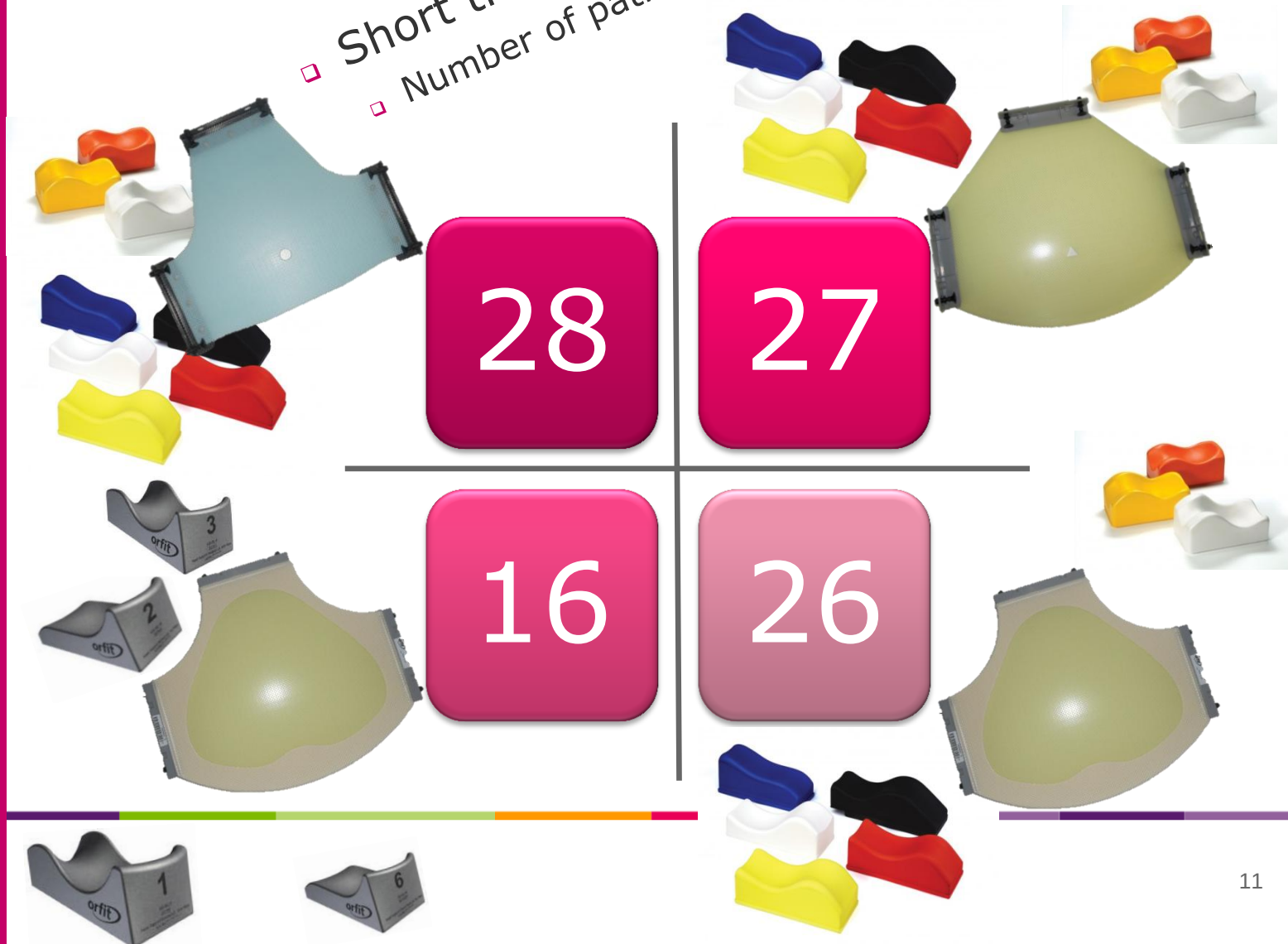
- Number of patients
  - For the short treatment-schedule 97 patients had finished their treatment. *15 patients stopped early or didn't start.*
  - In the long treatment-schedule 23 patients finished their treatment. *3 patients stopped early or didn't start.*

2 epi's a day for 12 day for 97 patients
2 epi's a day for 20 days for 23 patients

2 x 12 x 97 = 2328 epi's
2 x 20 x 23 = 920 epi's

Results:

- Short treatment-schedule
  - Number of patients



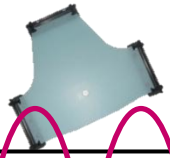
Results: Setup margins

Short treatment schedule

		Civco Posicast	Orfit Efficast	Orfit Hybrid	Orfit Hybrid Head Support
Number of Patients		28	27	26	16
Right/Left	**syst error Σ**	0,90 (0,75)	0,89 (0,69)	0,89 (0,79)	0,88 (0,79)
	random error σ	1,01 (0,93)	1,02 (0,97)	0,97 (0,91)	1,00 (0,96)
	Van Herk 2.5Σ + 0.7σ	2,96 (2,52)	**2,94 (2,41)**	2,91 **(2,60)**	**2,90** (2,63)
Ant/Post	**syst error Σ**	1,08 (1,62)	1,51 (0,56)	1,27 (0,85)	1,02 (0,66)
	random error σ	1,15 (1,07)	0,85 (0,91)	0,96 (0,99)	0,92 (0,90)
	Van Herk 2.5Σ + 0.7σ	**3,52** (4,80)	4,36 **(2,04)**	3,85 (2,81)	**3,21 (2,29)**
Inf/Sup	**syst error Σ**	1,06 (0,78)	1,05 (1,24)	0,91 (0,67)	0,73 (0,89)
	random error σ	0,84 (0,79)	0,91 (0,85)	0,89 (0,88)	0,81 (0,72)
	Van Herk 2.5Σ + 0.7σ	**3,24 (2,50)**	3,27 (3,68)	2,90 **(2,29)**	**2,38** (2,73)
3D total	**syst error Σ**	0,67 (1,06)	0,72 (0,95)	0,71 (0,58)	0,56 (0,62)
	random error σ	0,95 (1,06)	0,86 (0,86)	0,89 (0,88)	0,86 (0,87)
	Van Herk 2.5Σ + 0.7σ	**2,34** (3,28)	2,39 **(2,99)**	2,40 **(2,07)**	**2,00** (2,16)
	( ) Setup error correction after 3 days				Values in mm

Results: Setup margins

Short treatment schedule



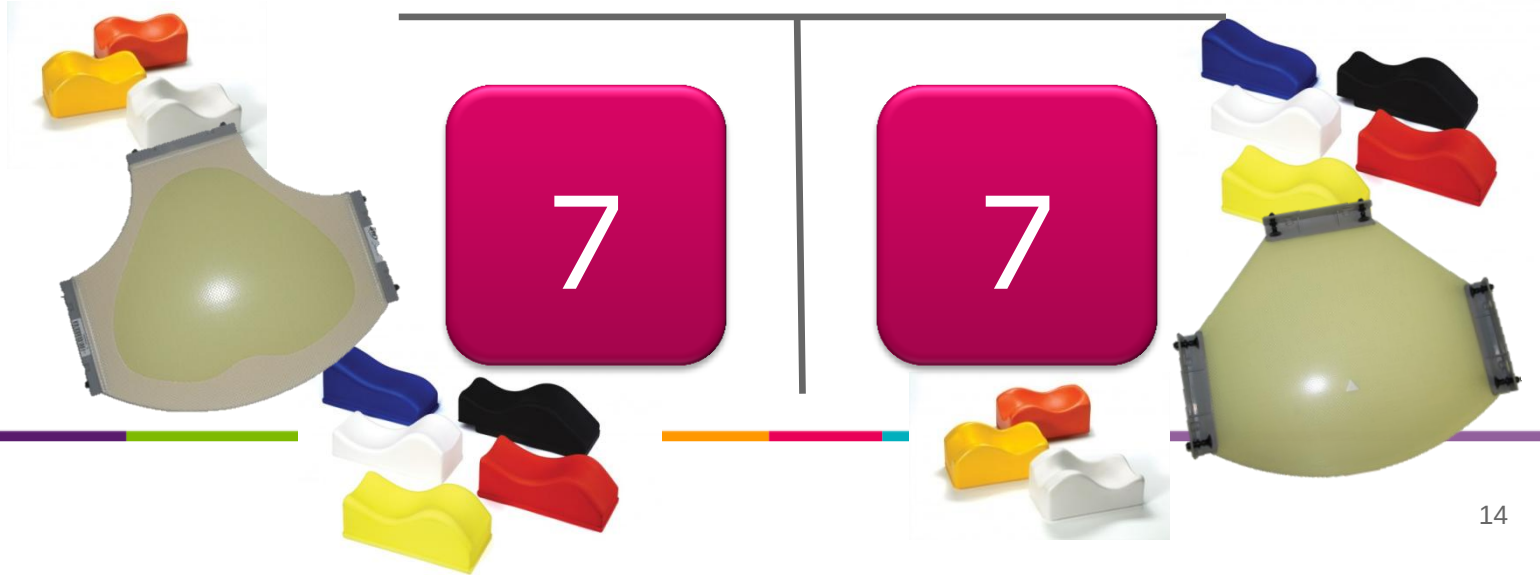
		Civco Posicast	Orfit Efficast	Orfit Hybrid	Orfit Hybrid Head Support
Number of Patients		28	27	26	16
Right/Left	**Van Herk 2.5Σ + 0.7σ**	2,96 (2,52)	**2,94** (**2,41**)	2,91 (**2,60**)	**2,90** (2,63)
Ant/Post	**Van Herk 2.5Σ + 0.7σ**	**3,52** (4,80)	4,36 (**2,04**)	3,85 (2,81)	**3,21** (**2,29**)
Inf/Sup	**Van Herk 2.5Σ + 0.7σ**	**3,24** (**2,50**)	3,27 (3,68)	2,90 (**2,29**)	**2,38** (2,73)
3D total	**Van Herk 2.5Σ + 0.7σ**	**2,34** (3,28)	2,39 (**2,99**)	2,40 (**2,07**)	**2,00** (2,16)

( ) Setup error correction after 3 days

Values in mm

Results:

- Long treatment-schedule
  - Number of patients



Results: Setup margins

Long treatment schedule

		Civco Posicast	Orfit Efficast	Orfit Hybrid	Orfit Hybrid Head Support
Number of Patients		9	7	7	0
Right/Left	**Van Herk 2.5Σ + 0.7σ**	3,88 (7,83)	**3,49 (2,14)**	2,96 (2,56)	
Ant/Post	**Van Herk 2.5Σ + 0.7σ**	**3,34** (2,83)	3,53 **(2,80)**	2,35 (2,49)	
Inf/Sup	**Van Herk 2.5Σ + 0.7σ**	3,45 **(2,01)**	**2,90** (2,56)	3,10 (2,38)	
3D total	**Van Herk 2.5Σ + 0.7σ**	**2,05** (4,29)	2,37 **(2,74)**	2,06 (1,86)	
	( ) Setup error correction after 3 days				Values in mm

- Long term stability
  - Setup margins are equal for short and long treatment schedule.

Results: Patient tolerance

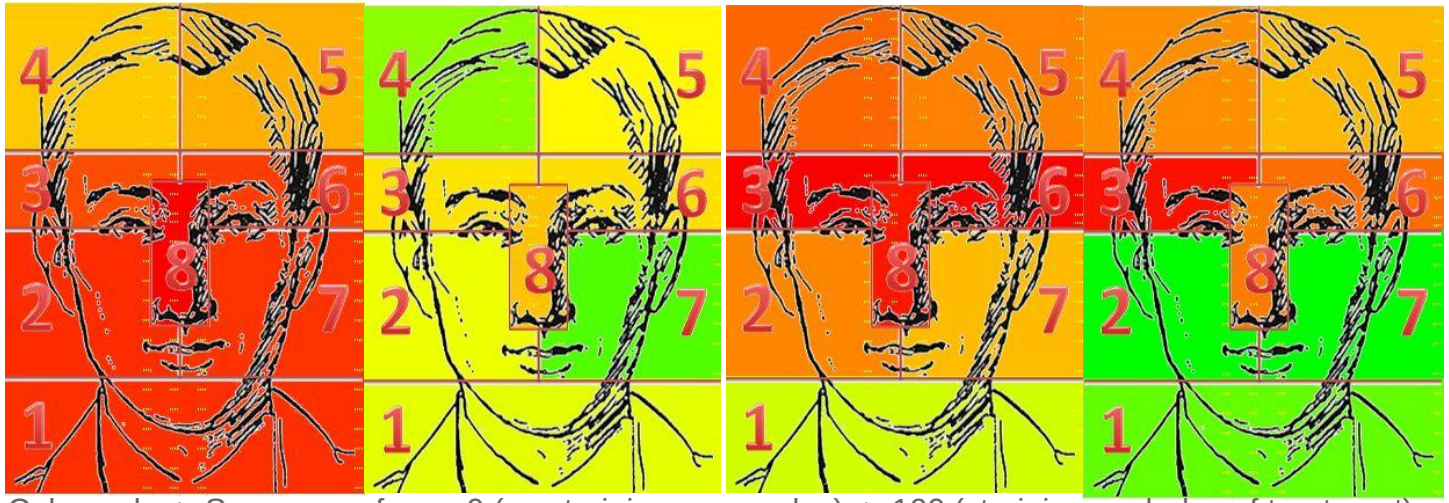
- Visual Pressure zones
  - Only data from the short treatment-schedule:

Presure Zone	Civco Posicast	Orfit Efficast	Orfit Hybrid	Orfit Hybrid Head Support
1	46,49	29,56	28,77	24,17
2	46,71	30,00	39,86	16,14
3	44,18	32,81	51,35	48,77
4	34,72	25,96	42,31	39,29
5	36,71	31,32	40,22	35,94
6	45,43	33,07	49,78	41,68
7	46,16	23,42	35,79	18,48
8	57,78	35,18	48,30	40,68
Mean	44,77	30,16	42,05	33,14
Score goes from : 0 (no straining on any day) -> 100 (straining each day of treatment)				

Results: Patient tolerance

- Pressure zones : visual view

Colorscale
<20
35
>50



Colorscale -> Score goes from : 0 (no straining on any day) -> 100 (straining each day of treatment)

Results: Patient tolerance

- Asking patient about discomfort or pressure.

Presure Zone	Civco Posicast	Orfit Efficast	Orfit Hybrid	Orfit Hybrid Head Support
1	12,46	6,49	11,56	11,29
2	6,98	1,93	11,35	5,15
3	6,08	4,39	13,44	2,67
4	6,75	2,19	6,15	4,41
5	8,02	3,42	7,19	5,32
6	7,59	4,39	13,02	7,15
7	7,86	2,19	10,52	4,24
8	20,36	8,33	15,83	16,82
Mean	9,51	4,17	11,13	7,13
Score goes from : 0 (no discomfort/pain) -> 100 (discomfort/pain each day of treatment)				

Conclusions

- In our case (we use the eNAL-Protocol) the Efficast mask from Orfit has smaller setup margins then the posicast mask from Civco .
- When using hybrid masks you could reduce the setup margin even further (± 2mm).
- Patient comfort is better with the Efficast masks from Orfit (less shrinking).

Thank you for your attention.