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STEREOTACTIC RADIOSURGERY
DOSIMETRY
DOSE CALCULATION ALGORITHM
QUALITY ASSURANCE
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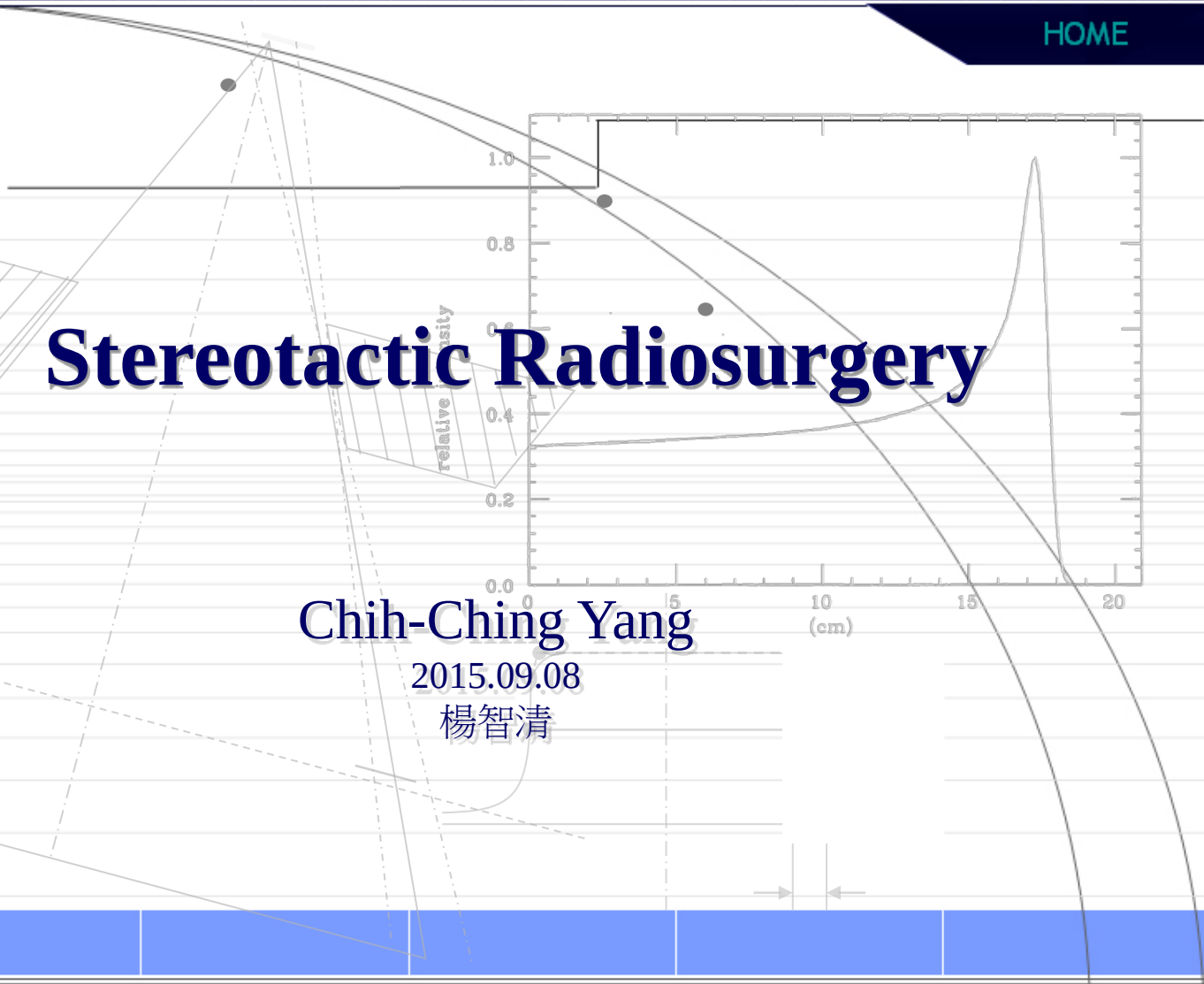


Stereotactic Radiosurgery

Chih-Ching Yang

2015.09.08

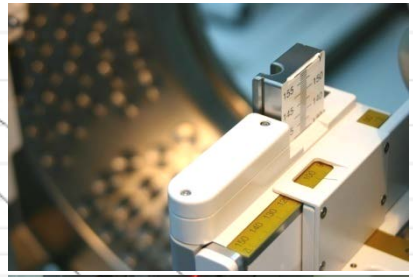
楊智清

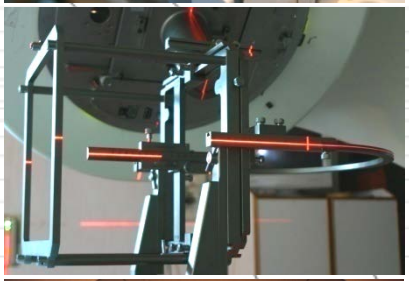
Introduction

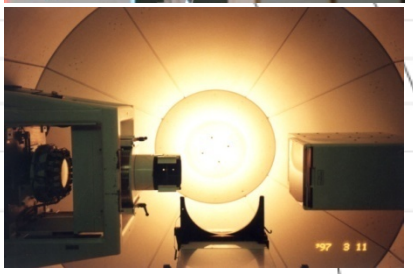
- The term radiosurgery was coined by a neurosurgeon Lars Leksell in 1951.
- Stereotactic radiosurgery (SRS) is a single fraction radiation therapy.
- Stereotactic apparatus and narrow multiple beams delivered through noncoplanar isocentric arcs.
- A high degree of dose conformity is a hallmark of SRS.
- Maximum error of ± 1.0 mm

SRS and SRT

- Cobalt-60 gamma rays
- Megavoltage x-rays
- Heavy charged particles







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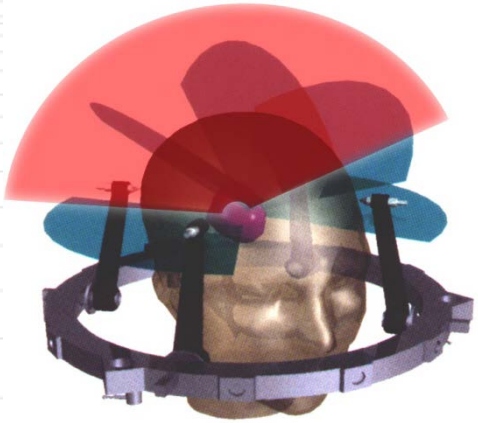
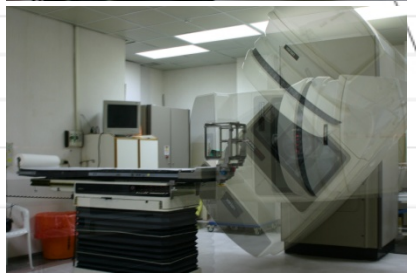
X Knife

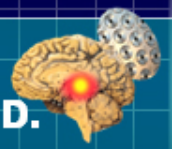
Stereotactic Radiosurgery

The linac-based SRS technique consists of using multiple noncoplanar arcs of circular beams converging on to the machine isocenter, which is stereotactically placed at the center of imaged target volume.



multiple coplanar or noncoplanar arcs





Stereotactic Frame

X Knife

- There are basically two lina-based SRS systems: pedestal-mounted frame and couchmounted frame. Which is attachable to the patient's skull as well as to the couch or pedestal.
- The most noteworthy of the SRS frames are: Leksell, Riechert-Mundinger, Todd-Wells, and Brown-Robert-Wells (BRW).
- A special relocatable head ring, called the Gill-Thomas-Cosman (GTC), has been designed for fractionated SRT.
- The CT localizer frame is equipped with nine fiducial rods, which appear as dots in the transaxial slice image.

Stereotactic Frame	Linac Isocentric Accuracy	Stereotactic Accuracy	Overall Accuracy	Beam Collimation

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Stereotactic Frame

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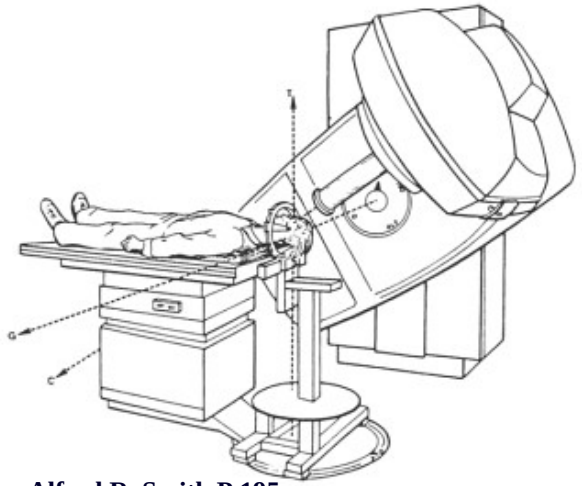
External Beam Stereotactic Radiosurgery Physics 195

Fig. 10.1. The Joint Center hardware configuration, with the BRW pedestal mounted on the PSA base plate. The stereotactic frame is attached to the stand with the target positioned at the locus of the rotation axes of the gantry, table, and collimator



Radiation Therapy Physics; Alfred R. Smith P.195

Stereotactic Frame	Linac Isocentric Accuracy	Stereotactic Accuracy	Overall Accuracy	Beam Collimation

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- There are basically two lina-based SRS systems: pedestal-mounted frame and couchmounted frame. Which is attachable to the patient's skull as well as to the couch or pedestal.

couchmounted frame

http://houshasen-chiryou.com/advanced/machine/

Stereotactic Frame	Linac Isocentric Accuracy	Stereotactic Accuracy	Overall Accuracy	Beam Collimation

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Stereotactic Frame

X Knife

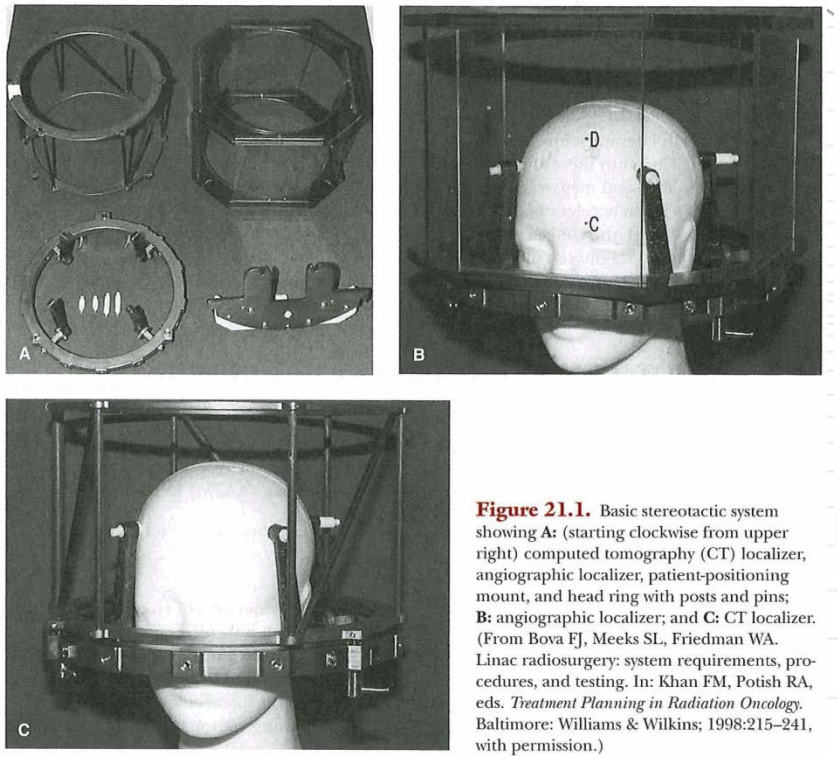


Figure 21.1. Basic stereotactic system showing **A:** (starting clockwise from upper right) computed tomography (CT) localizer, angiographic localizer, patient-positioning mount, and head ring with posts and pins; **B:** angiographic localizer; and **C:** CT localizer. (From Bova FJ, Meeks SL, Friedman WA. Linac radiosurgery: system requirements, procedures, and testing. In: Khan FM, Potish RA, eds. *Treatment Planning in Radiation Oncology.* Baltimore: Williams & Wilkins; 1998:215–241, with permission.)

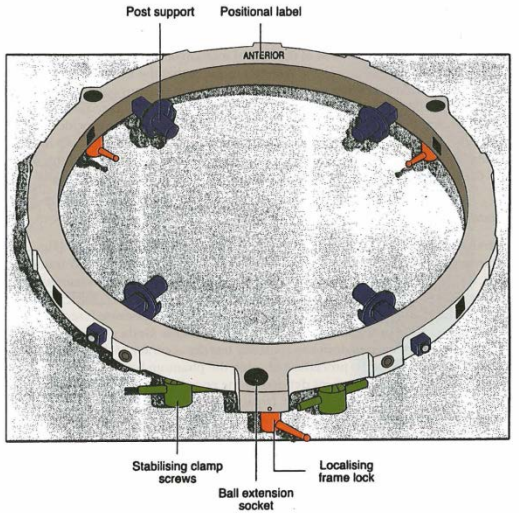
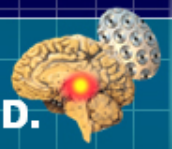


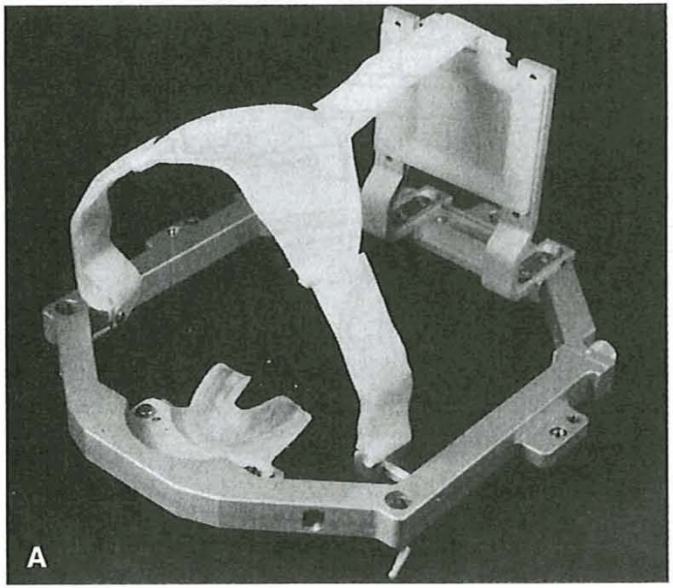
Figure 21.2. Schematic drawing of Brown-Robert-Wells frame. (From Cho KH, Gerbi BJ, Hall WA. Stereotactic radiosurgery and radiotherapy. In: Levitt SH, Khan FM, Potish RA, et al., eds. *Technological Basis of Radiation Therapy.* Philadelphia: Lippincott Williams & Wilkins; 1999:147–172, with permission.)

Stereotactic Frame	Linac Isocentric Accuracy	Stereotactic Accuracy	Overall Accuracy	Beam Collimation



Stereotactic Frame

X Knife



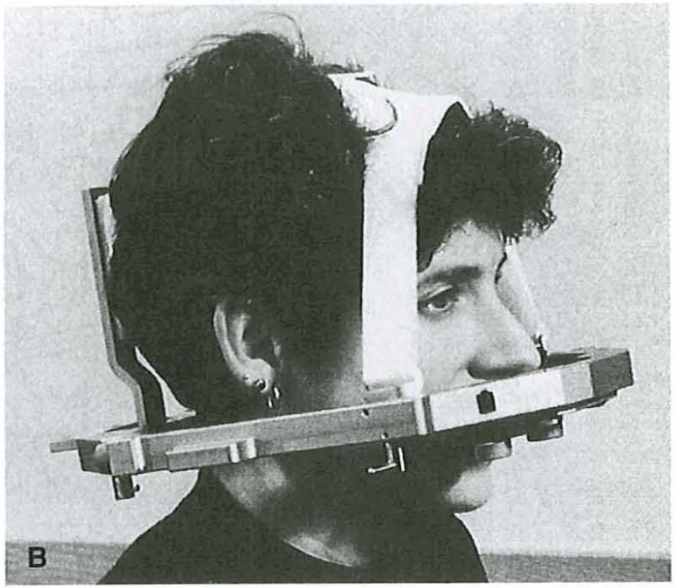


Figure 21.3. **A:** The Gill-Thomas-Cosman (GTC) relocatable head ring with bite block and Velcro straps. **B:** The GTC head ring worn by the patient. (From Cho KH, Gerbi BJ, Hall WA. Stereotactic radiosurgery and radiotherapy. In: Levitt SH, Khan FM, Potish RA, et al., eds. *Technological Basis of Radiation Therapy.* Philadelphia: Lippincott Williams & Wilkins; 1999:147–172, with permission.)

Stereotactic Frame	Linac Isocentric Accuracy	Stereotactic Accuracy	Overall Accuracy	Beam Collimation

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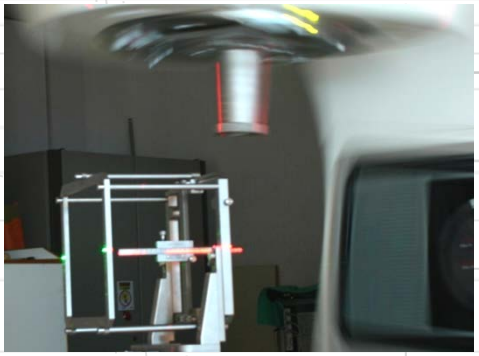
Beam Collimation

X Knife

Long circular cones

- As stated previously, attachment of long cones below the x-ray jaws extends the SDD, thus reducing the geometric penumbra.
- cone – from 1.25 to 5.00 cm step 0.25 cm
- 15-cm-long circular cones



Stereotactic Frame	Linac Isocentric Accuracy	Stereotactic Accuracy	Overall Accuracy	Beam Collimation

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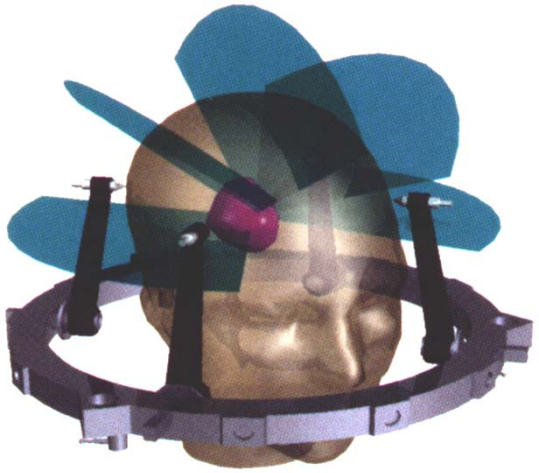
- 非侵襲性(Noninvasive)
- 聚焦式放射手術(Focal Irradiation)
- 單次高劑量(Signal Treated & High Dose)
- 高準確性定位(High Positional Accuracy)
- 小體積腫瘤(Small Volume)

X Knife



Stereotactic Radiosurgery

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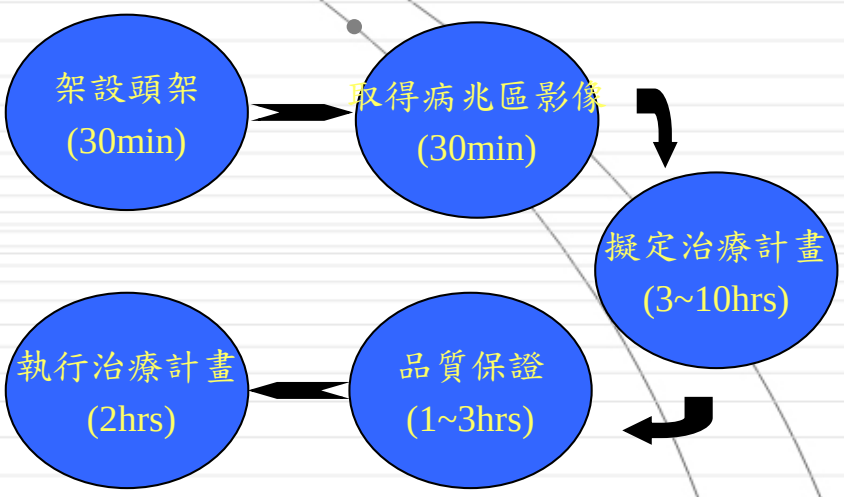
X Knife

- 將病患以Radionics BRW系統固定頭部及當做定位座標
- 利用電腦斷層取得3mm一張之病兆區影像
- 利用XKnife-3治療計畫軟體擬定治療參數
- 依照治療計畫做品質保證，以確保定位誤差在+-1mm內
- 使用Varian直線加速器4MV治療病患



療程7~16小時

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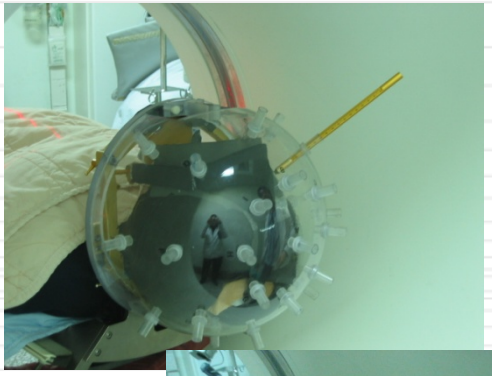

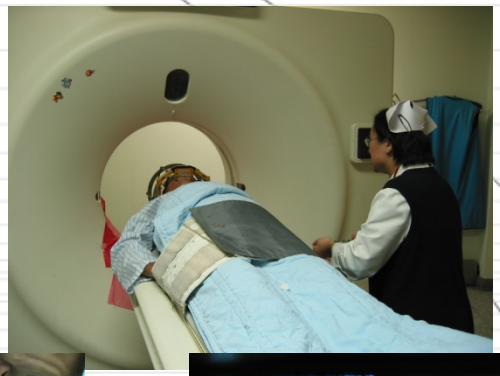

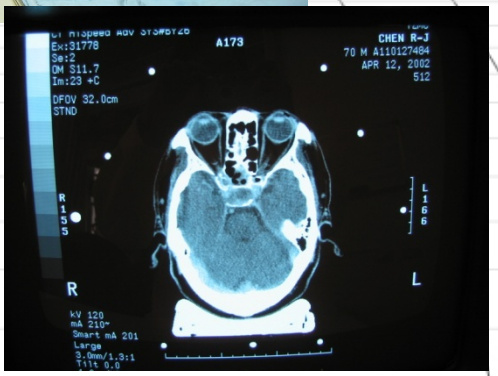

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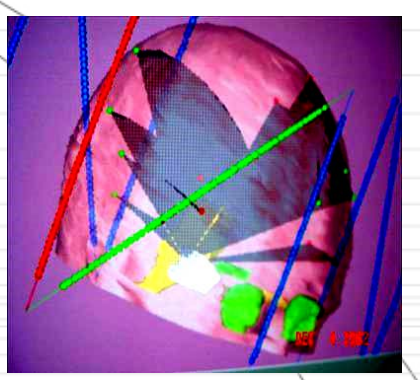
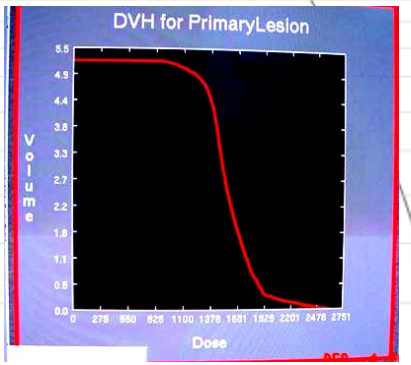
- 依腫瘤體積及形狀決定中心點數目 (Number of Isocenter)
- 依腫瘤位置決定射束角度(Arc Degree)
- 劑量-體積圖(Dose Volume Histogram)
- 高劑量區與低劑量區位置(Hot spot and cold spot)
- 80%劑量之體積與腫瘤比值(Tumor Volume Ratio)

X Knife





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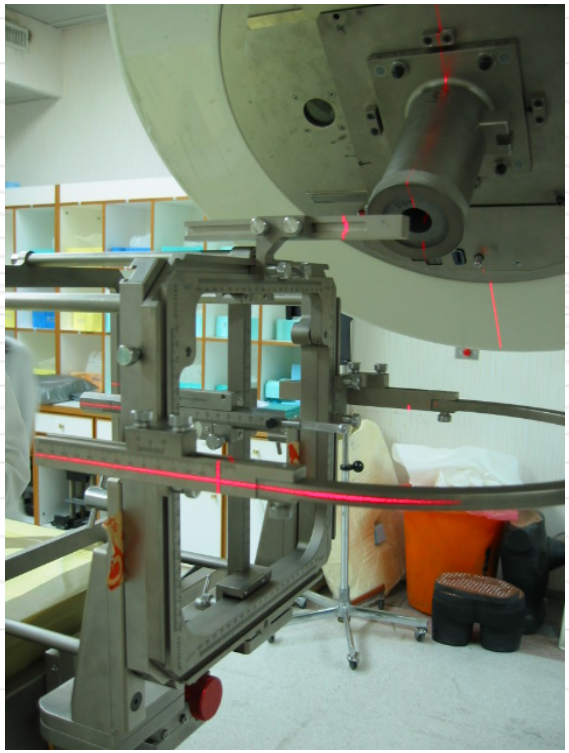

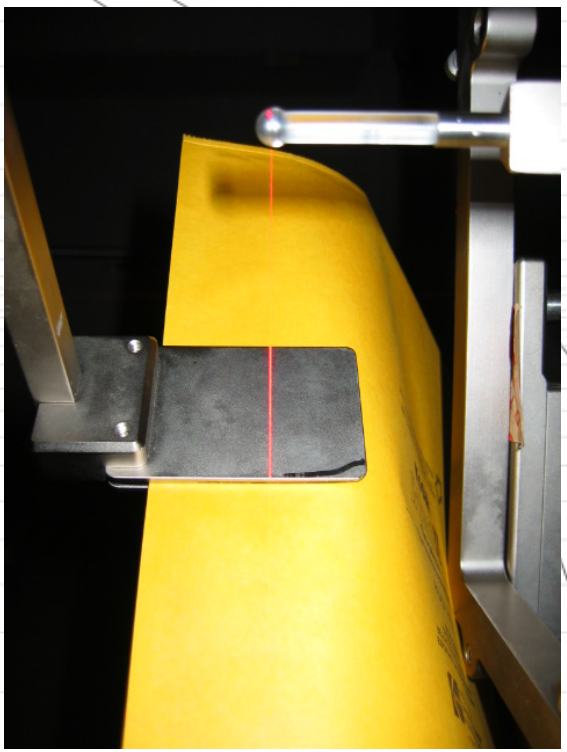

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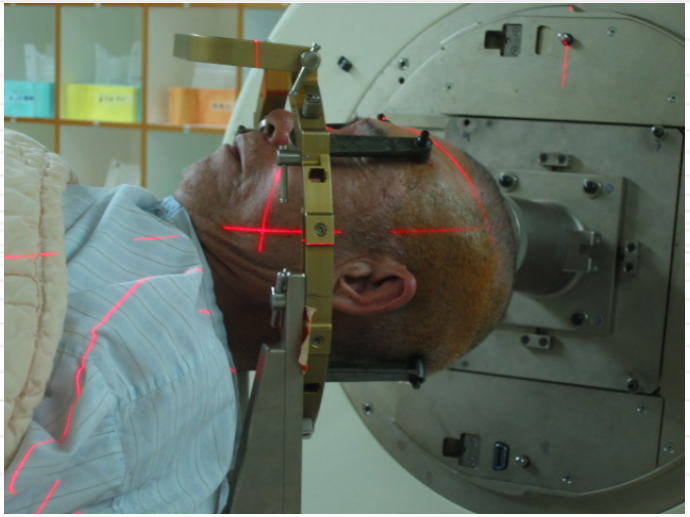
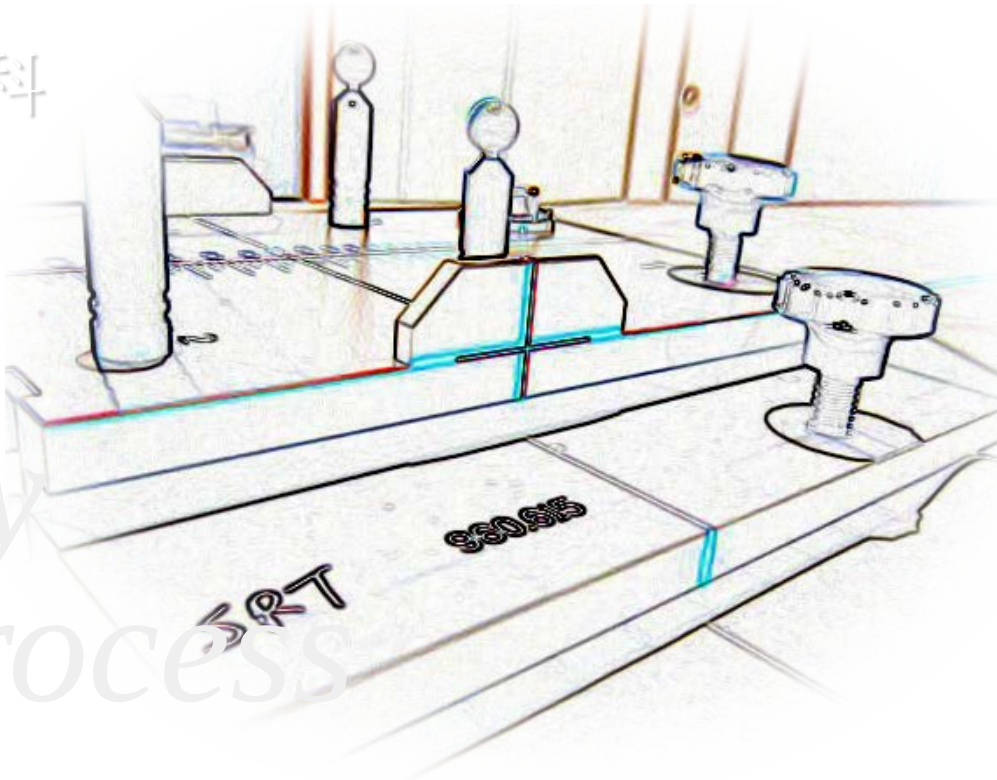


立體定位放射治療定位流程

花蓮慈濟醫學中心放射腫瘤科
江志軒

Stereotactic RadioTherapy positioning process



立體定位放射治療定位流程

Stereotactic RadioTherapy

01 攝影機校正
Camera Calibration

02 製作齒模
Bite Block Preparation

03 測試齒模
Bite Block Reseat verification test

04 製作頭枕
Head cushion preparation

05 製作面膜
Head mask preparation

06 取得CT影像
Patient CT

07 治療計劃
Treatment Planning

08 OGP影像連結
Registration

09 OGP位置驗證
Registration Verification

10 治療
Patient Treatment

立體定位放射治療定位流程

Stereotactic RadioTherapy

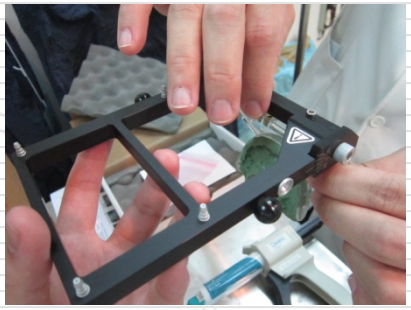
齒模板
Bite tray

固定咬合、反射螢光球架

齒模材料
Dental Caulk kit

製作齒模

反射螢光球架
Reference Fiducial Frame



定位座標

齒模驗證環
Reseat verification Jig

驗証齒模是否良好

U型面膜
Thermoplastic mask

固定面型

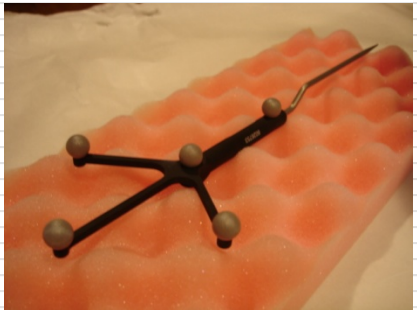
塑型頭枕
Cushion

穩定頭部

立體定位放射治療定位流程

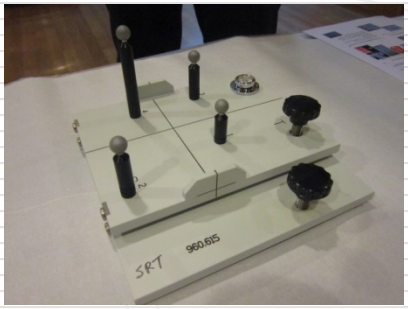
Stereotactic RadioTherapy

位置指示器
Blunt Pointer



辨認正確位置

攝影機校正器
Camera Calibration Jig



校正攝影機

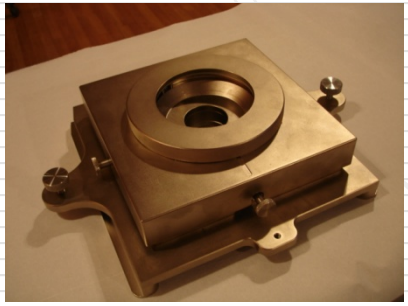
光學導引系統
Optical Guidance Platform(OGP)

顯示座標

圓錐
Cone

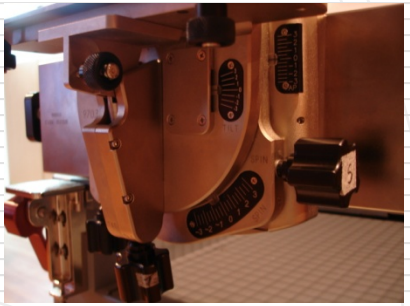
圓形輻射照野

圓錐支架
Collimator Holder



支撐圓錐

方位調整架
3DOF



調整左右上下及傾斜角度

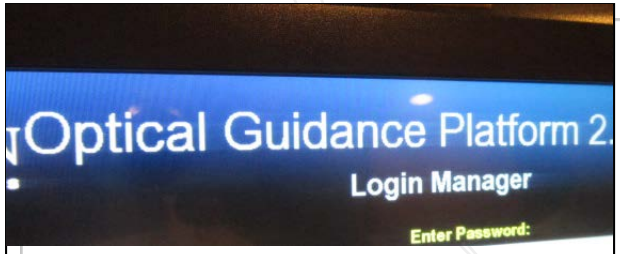
立體定位放射治療定位流程
Stereotactic RadioTherapy

攝影機校正
Camera Calibration

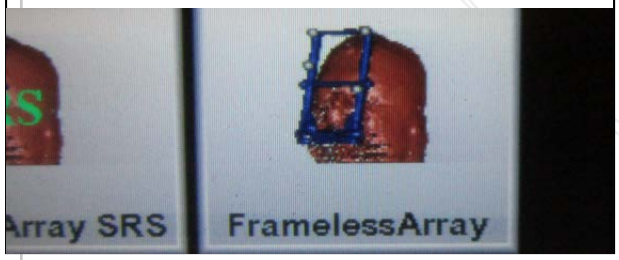
開機須超過2小時，才可進行校正。camera 指示燈顯示兩個綠燈即可。

製作齒模
Bite Block Preparation

測試齒模
Bite Block Reseat verification test



製作頭枕
Head cushion preparation



在**OGP**上按FramelessArray 。

製作面膜
Head mask preparation

立體定位放射治療定位流程

Stereotactic RadioTherapy

攝影機校正
Camera Calibration

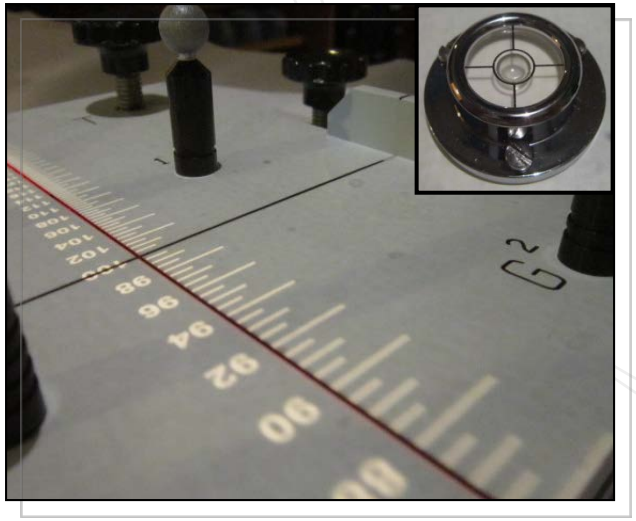
製作齒模
Bite Block Preparation

測試齒模
Bite Block Reseat verification test

製作頭枕
Head cushion preparation

製作面膜
Head mask preparation

將**攝影機校正器**(Camera Calibration Jig)放置於**SAD**位置。



注意擺放**方向**及**水平**。

立體定位放射治療定位流程

Stereotactic RadioTherapy

攝影機校正
Camera Calibration

製作齒模
Bite Block Preparation

測試齒模
Bite Block Reseat verification test

製作頭枕
Head cushion preparation

製作面膜
Head mask preparation

讓病患試咬(6分力)。

將**齒模材料** (Dental Caulk kit)放入齒模板，整平後放入病患口中並稍微調整位置約5分鐘。

立體定位放射治療定位流程

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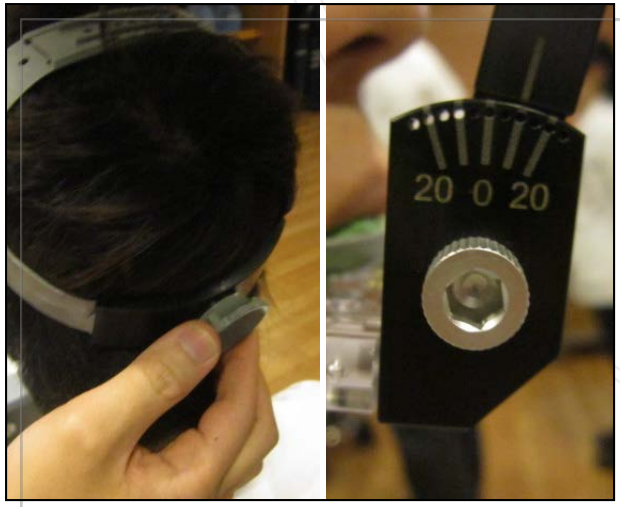
Bite Block Reseat verification test

製作頭枕
Head cushion preparation

製作面膜
Head mask preparation

將**齒模驗證環**(Reseat verification Jig)套於病患頭上，並請病患正確咬住齒模。



齒模驗證環須調緊、驗證環上的角度調整向camera方向傾斜10度，以方便驗證。

立體定位放射治療定位流程

Stereotactic RadioTherapy

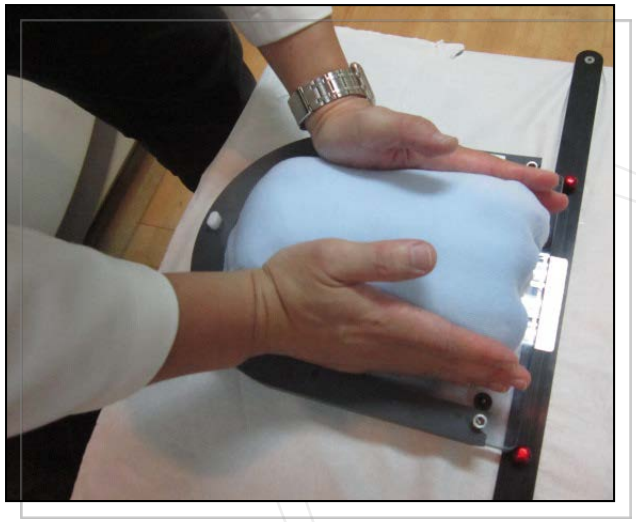
攝影機校正
Camera Calibration

製作齒模
Bite Block Preparation

測試齒模
Bite Block Reseat verification test

製作頭枕
Head cushion preparation

製作面膜
Head mask preparation



將塑型頭枕放置於**U型環**內，並讓病患直接躺下。

五分鐘內快速塑型後，讓塑型頭枕硬化。讓病患試躺至習慣為止(至少三次)。

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製作面膜
Head mask preparation

製作面膜
約5分鐘後定型取出。

讓病患起身，再次試戴後如合適才作記號並寫上病患姓名日期。

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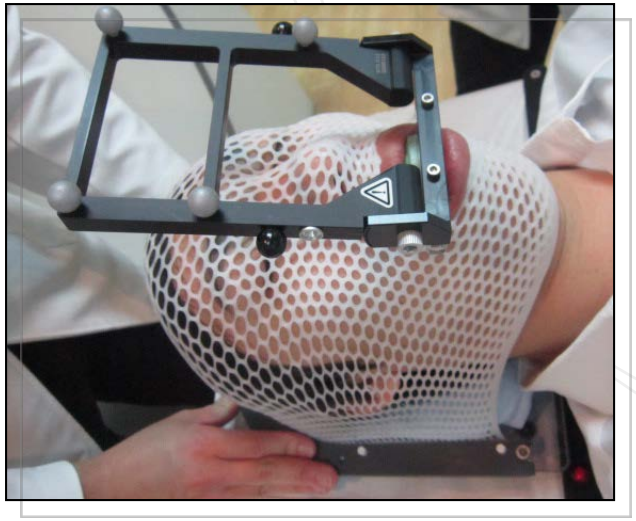
Registration

OGP位置驗證
Registration Verification

治療
Patient Treatment

將齒模板裝上反射螢光球架。



面膜戴於病患上並調整位置。

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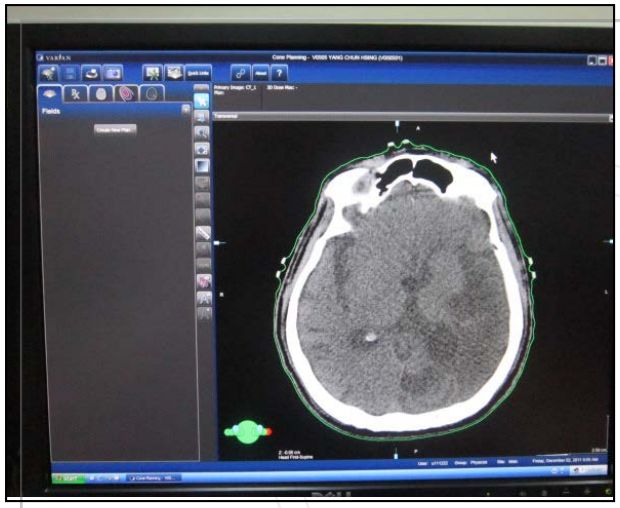
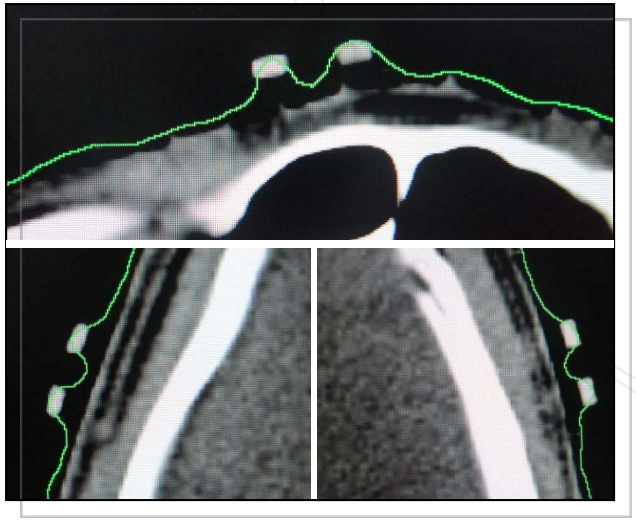


(1) 載入病患資料。
(2) Isocenter數目不大於3個(最佳為1個)，每個Isocenter的Arc不大於5 個。
(3) 以較佳之cone先包覆Tumor主體約90%，未包覆之不規則處另加Arc包覆，如若不夠，再選較大之cone，依此類推



(4) 若(3)之狀況無法處理，則加Isocenter
(5) 可能超過三個Isocenter之Planning則應與醫師商量
(6) 設定Prescribe dose 為 80%或70%，直接劃PTV
(7) 治療計劃結束後，傳送至OGP及Aria

註：反射螢光球架可免畫

立體定位放射治療定位流程

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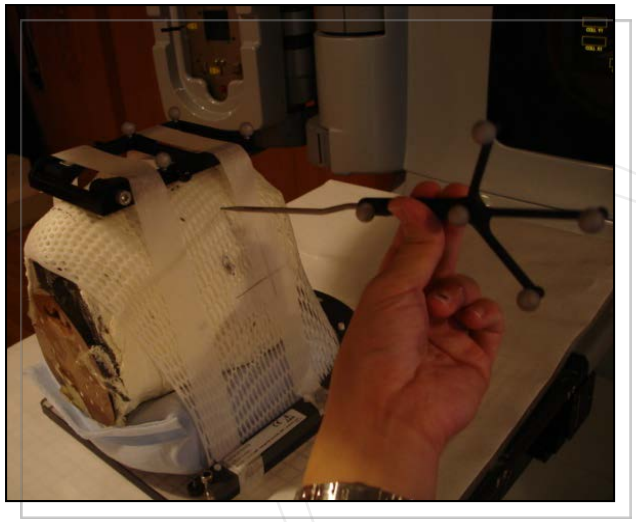
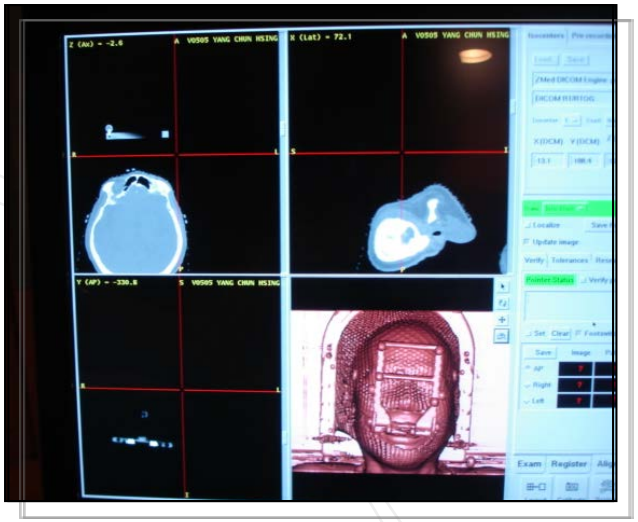
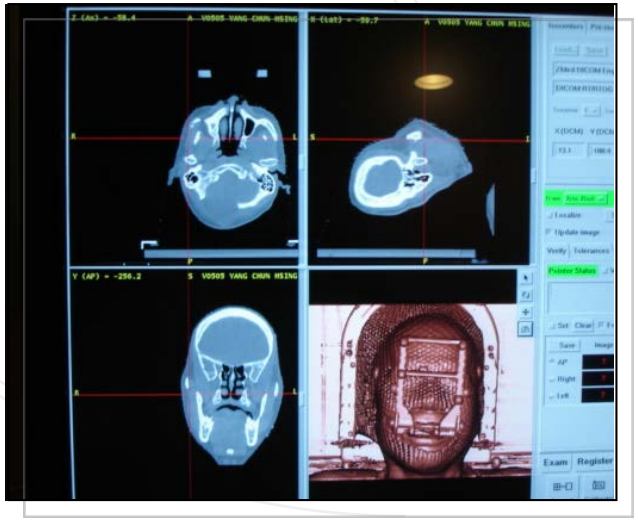




治療計劃
Treatment Planning

OGP影像連結
Registration



OGP位置驗證
Registration Verification

治療
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立體定位放射治療定位流程

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(4) 先調整Tilt再調整Spin、AP、Lat 或者Ax，Longitudinal(Z軸)需由Table調整

(5) 調整好後，Gantry轉至最接近180°之治療位置角度 (水平下方)
(第一次治療需看燈光投影是否有避開危急器官)

立體定位放射治療定位流程

***S**tereotactic **R**adio**T**herapy*

感謝

放射腫瘤科醫事放射師同仁

慈濟技術學院 放射技術系 陳延昭同學