

# Computer assisted stereotactic surgery

By Linda Clarke, R.N.

Stereotactic surgery is a neurosurgical technique which enables the surgeon to precisely localize and biopsy a deep seated brain lesion, or aspirate an abscess or cyst, with minimal damage to underlying structures. At St. Boniface General Hospital in Winnipeg, Manitoba, the Brown, Roberts, Wells, CT guided stereotaxic guidance system is used.

## The Brown-Robert-Wells system

The Brown-Robert-Wells system, sometimes referred to as the BRW system has five functional components:

### I. Heading with accessories (sterile components)

The heading comes complete with the equipment needed to secure the heading to the patient's head. This equipment includes two sizes of pins (short and long), posts through which the pins will be inserted, a special screwdriver and velcro strap. When secured

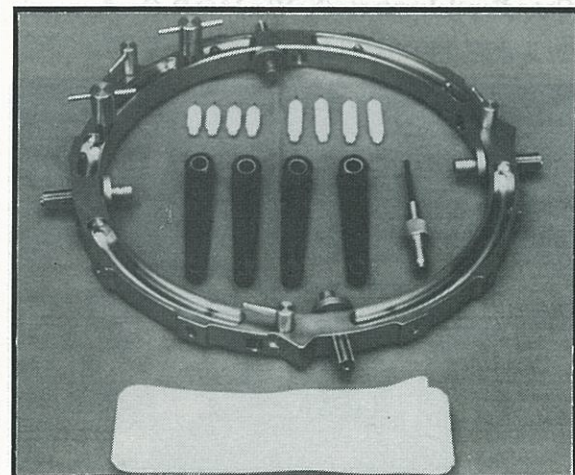


Figure 1. Heading with pins, carbon posts, screwdriver and velcro strap.

to the head, it gives the surgeon a fixed and immobile base to which he can attach the other components of the system. (Figure 1) This part of the procedure is done on the ward with local anaesthesia. It remains on until the surgery is completed.

### II. The localizing ring (unsterile components)

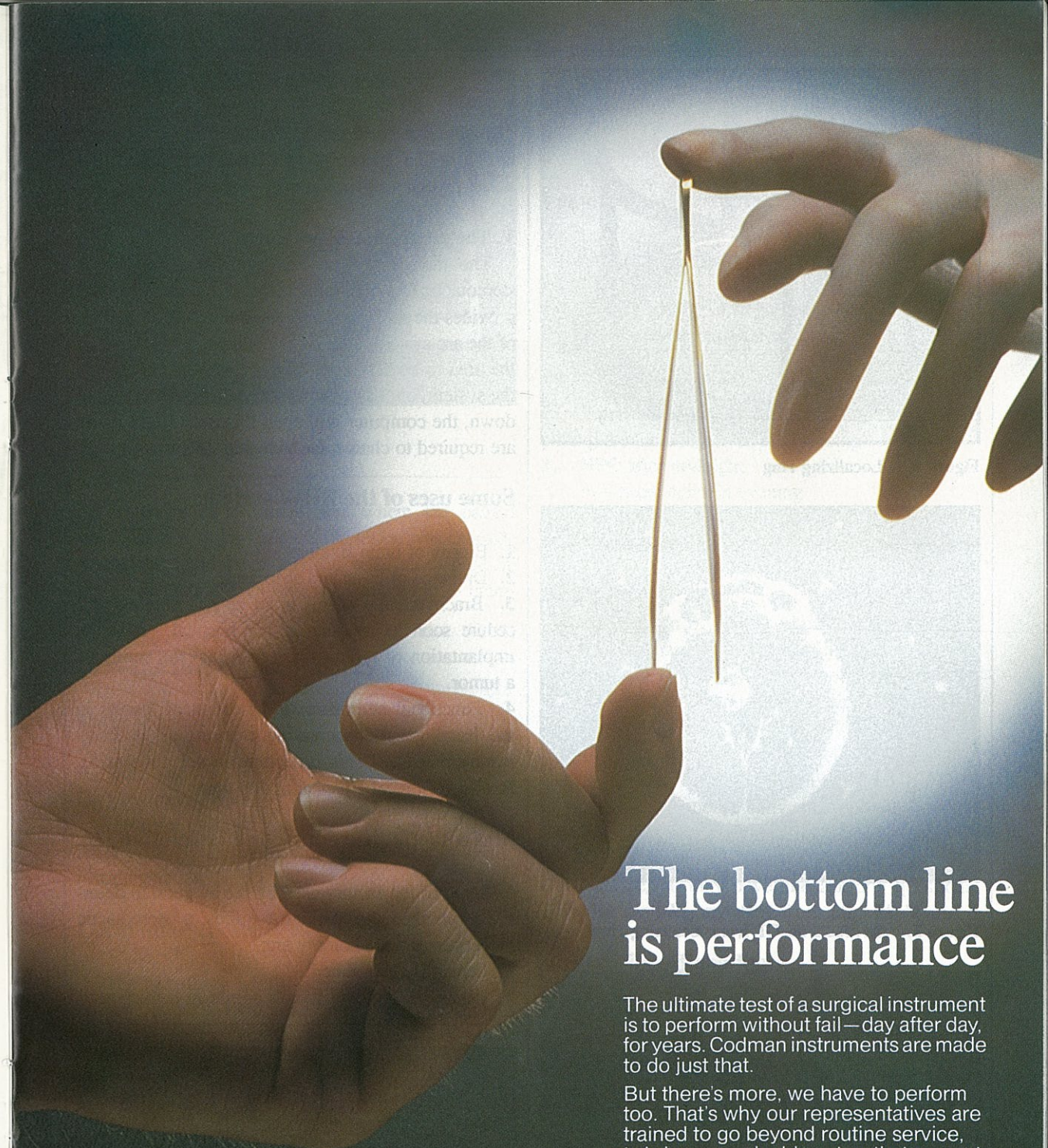
The sole purpose of the localizing ring and an important one, is to provide the artifacts or landmarks on the CT scan. The ring has six vertical and three diagonal graphite rods. (Figure 2, next page) The scanning intersects these rods appearing as landmarks around the head. (Figure 3) These landmarks enable the radiologist and surgeon to obtain the coordinates needed to determine the exact position of the target.

### III. Arc guidance system (sterile component)

The arc system consists of a base ring, rotatable ring and a perpendicular arc. Contained within the base ring are three mounting balls which fix the base ring accurately to the heading. It is used to calculate the coordinates of any entry point which may be derived from the CT scan, or from the surface of the patient's scalp. The arc also guides and directs the passage of the drill and biopsy forcep during the surgery. (Figure 4)

### About the author

Linda Clarke, R.N., a graduate of Fanshawe College, Victoria Campus, London, Ontario, is currently Assistant Head nurse - Neurosurgery and Paediatric Surgery, Operating Room, St. Boniface General Hospital, Winnipeg, Manitoba. This article on stereotactic surgery was taken from an address the author delivered at the 2nd Biennial Conference of the Manitoba Operating Room Nurses Association held in Winnipeg in 1987.



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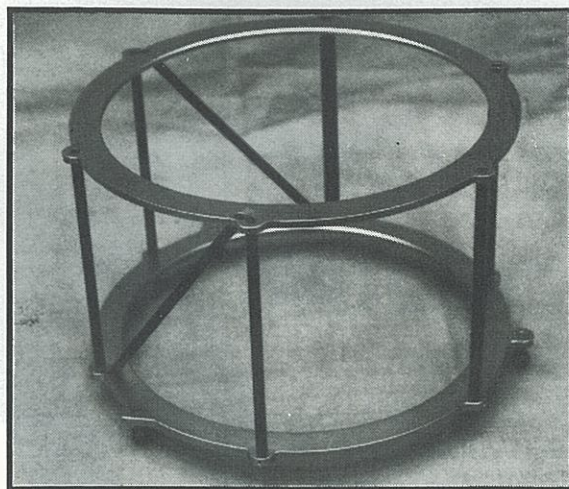


Figure 2. Localizing ring

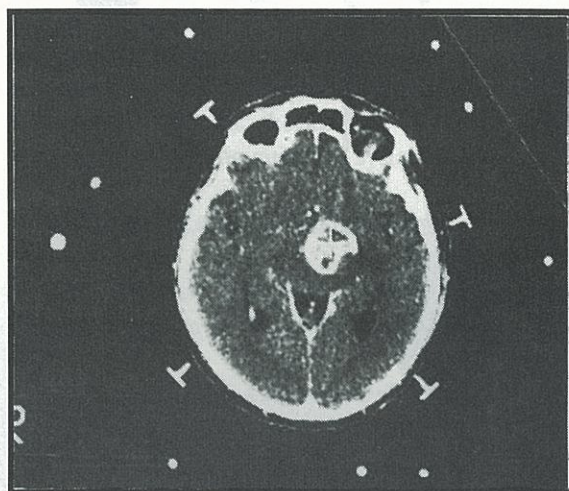


Figure 3. Artifacts on CT from localizing ring

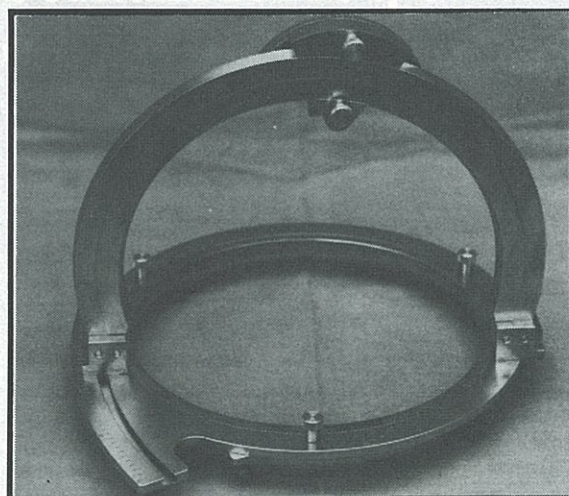


Figure 4. Arc guidance system

#### IV. Phantom simulator (unsterile component)

This component allows the surgeon to simulate the biopsy or aspiration, thereby indentifying any errors in the transcription of the data before the actual procedure is performed. (Figure 5)

#### V. The programmable computer

The table top computer specially designed for stereotactic surgery handles the calculations and provides the measurements for the correct alignment of the arc system, and for calculation of the depth of the area to be biopsied. Two computers come with the system, one as a backup. When the batteries run down, the computer will spell this out. Eight hours are required to charge the batteries. (Figure 6)

#### Some uses of the BRW system:

1. Biopsy of brain lesions.
2. Drainage of cysts and abscesses.
3. Brachytherapy - This is an up and coming procedure soon to be done at our hospital. It is the implantation of radioactive seeds into the centre of a tumor.
4. Functional neurosurgery - creation of lesions in the basal ganglia decreasing tremors, as in Parkinson's disease. This procedure is not done at St. Boniface General Hospital at this time.

#### Stereotactic procedure or a craniotomy?

Some of the factors used by the surgeon to determine whether the patient requires a stereotactic procedure or a craniotomy are:

1. Lesion is deep-seated.
2. Lesion located on patient's dominant hemisphere.

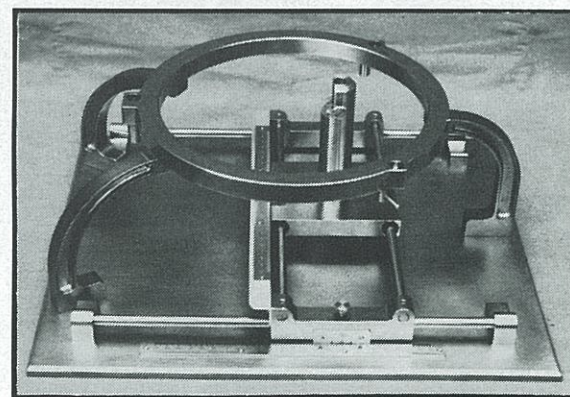


Figure 5. Phantom simulator



Figure 6. Programmable computer

3. Lesion is in a critical area where the patient would have a major deficit if the lesion was excised.
4. Patient could be a medical risk: other medical problems, and not capable of tolerating a craniotomy or a general anaesthetic.

#### How the surgery is performed

##### Three approaches:

- A. Twist drill
- B. Burr hole
- C. Craniotomy (rare)

All of our cases to date have been done through a twist drill. This enables us to use very minimal instrumentation.

#### Local anaesthesia

The nice thing with this procedure is that it can be done under a local anaesthetic. The advantages are many:

- A. The surgeon has the patient's cooperation throughout the procedure. This is extremely important as the patient is required to remain still throughout the procedure.
- B. The surgeon is able to communicate with the patient at all times. When the lesion is located on the patient's dominant hemisphere, the surgeon is able to get the patient to move an arm or leg, squeeze someone's hand, or to answer questions while the biopsy is being performed. This task would be impossible under a general anaesthetic.
- C. Recovery time is short - 99% of patients go home the next day. Biopsy results take about a

week and usually there is no need for the patient to remain in the hospital.

D. Fewer side effects from a local anaesthetic vs. a general anaesthetic.

#### Pre-op Visit

The pre-op visit is an important aspect of the surgery. Since the patient will be awake for the surgery it is beneficial to go over the procedure with the patient with the assistance of pictures.

##### Points covered on visit:

1. Approximate time that the surgeon will be putting the heading on in the morning
2. NPO after midnight
3. Full head shave in evening
4. Visit by anaesthetist
5. Establishment of an intravenous for fluids, IV medications (ie. Decadron), and for injection of contrast during the CT scan
6. Explanation of how the heading is put on by surgeon. Emphasis is on local infiltration and its discomfort; the tightening of the heading; instrumentation is hand held, no power equipment used
7. Visit to CT unit
8. Procedure on arrival to O.R
9. Prepping of head with warm antiseptic solution
10. Draping of patient's body with sterile sheets
11. Duration of stay in P.A. - or return to ward

The patient is given an opportunity to verbalize any fears he/she may have and ask any questions. This visit can take anywhere from 1/2 - 3/4 hours.

#### Application of heading

Early in the morning the perioperative nurse arrives so the chart can be reviewed for completeness prior to surgery. The working area is prepared, usually the overhead table. The patient is asked to empty his/her bladder prior to start of the procedure. The patient sits on the edge of the bed and pillows are placed behind for support. The heading is prepared for the surgeon's arrival using sterile technique.

The surgeon arrives and prepares the heading. The head is prepped with an antiseptic solution. The heading is balanced on the patient's head with assistance of the velcro strap. Once in correct place, carbon posts will be adjusted with screwdriver so they are flush with the scalp. The local anaesthetic is infiltrated into the four areas where the plastic

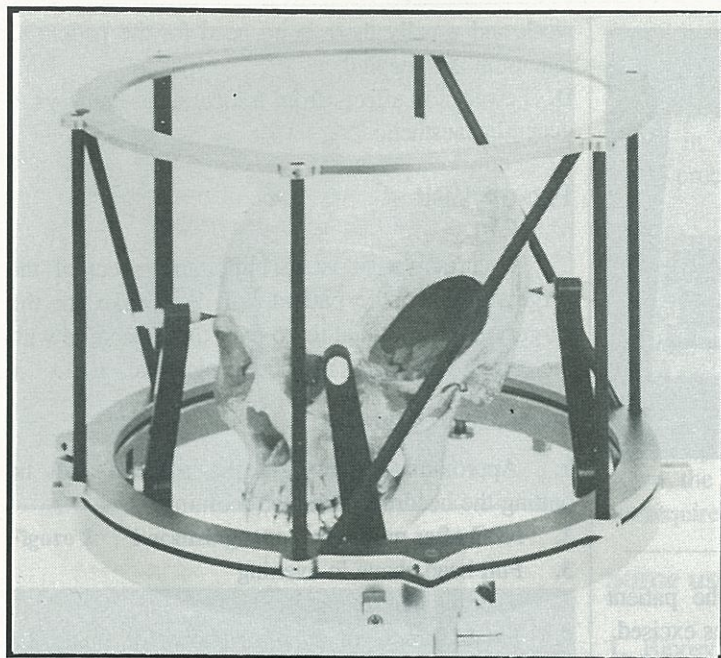


Figure 7. The localizing ring is locked on to the headring

pins will be inserted. The pins will be screwed through the post openings with the fingers. At times the two front pins cause pain, even with the local. This is because of the muscle that has to be penetrated. The pins are tightened with the special screwdriver. This will cause pressure and discomfort to the patient, but will only last a very short time. The headring will be tested for security and the velcro strap removed. If the patient continues to have any discomfort, additional local anaesthetic will be infiltrated at that particular pin site. The headring is comfortable once on. Sometimes a little comfort and reassurance is needed once the headring is in place. Pre-op medication is given as ordered.

### CT unit

The patient is assisted onto the stretcher and taken to the CT unit by the surgeon. The surgeon takes the localizing ring with him/her to be locked on the headring once in the CT unit. (Figure 7 above) Patient is positioned on the table by the nurses in CT room. Surgeon injects the contrast media via the intravenous. Scanning takes approximately 15 minutes - 20 minutes if any retakes are needed. The scanning intersects the nine rods on the localizing ring. The nine artifacts are required to determine the exact position of the target relative to the headring. Once scanning is complete, patient is taken directly

to the O.R. With the software in the scanning computer the X & Y coordinates of each of the artifacts are obtained. This is done by the radiologist, by placing the cursor on each of the artifacts including the target. Each coordinate is transcribed by the surgeon onto a special sheet provided by the manufacturer. This is taken by the surgeon to the O.R. A print of each scan is also taken and brought over to the O.R. for after-verification, if needed.

### Preparation of patient for O.R.

While the coordinates are being obtained the patient is brought over to the O.R. theatre. The patient is settled on the table, BP cuff and monitor leads are placed on, pillow positioned under the knees, safety strap placed on above

knees, and arms secured. Surgeon will position the headring to the table with the last component of BRW system, the Mayfield adaptor. (Figure 8)

The headring is secured and the head is prepared according to surgeon's preference with a warm antiseptic solution. Patient's body is draped with sterile draping. Great care is taken to maintain a sterile field. The headring, which was placed on under sterile conditions, is no longer sterile.

### The arc system and entry point

The surgeon now determines the entry point. As mentioned earlier, the surgeon will use the sterile arc system and use the surface of the patient's scalp. The arc is part of the scrub nurse's set-up. It has

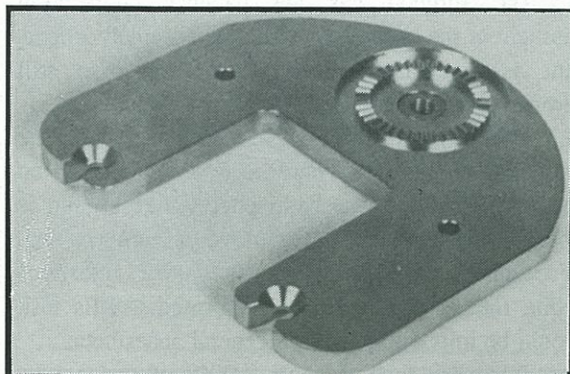
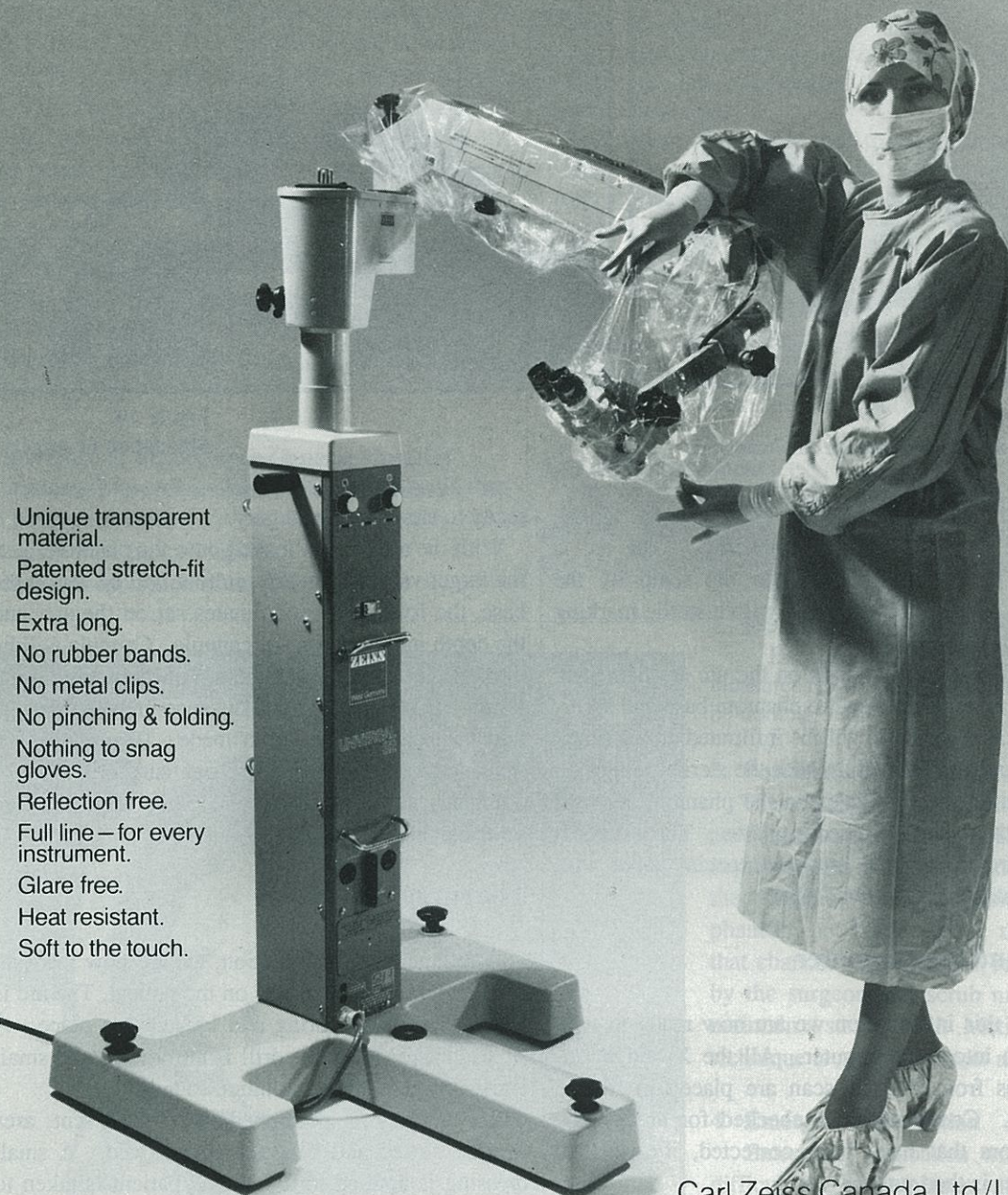


Figure 8. Mayfield adaptor

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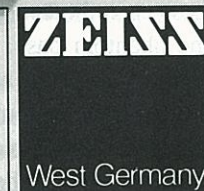
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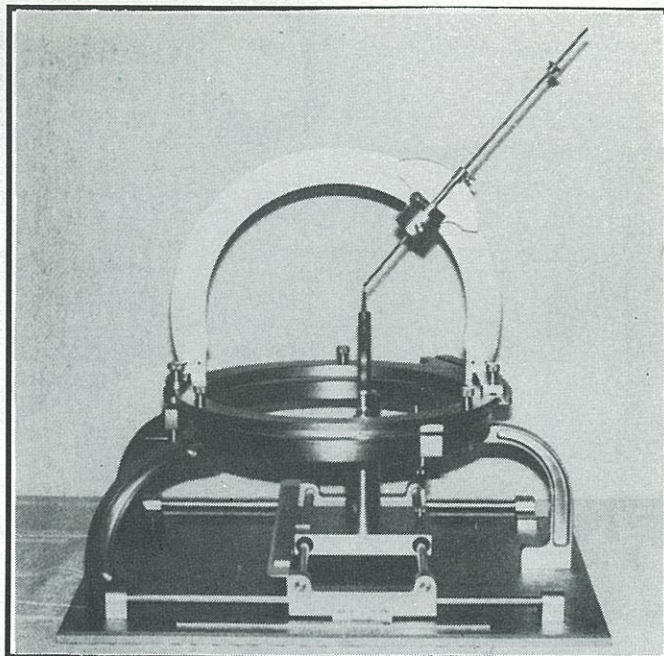
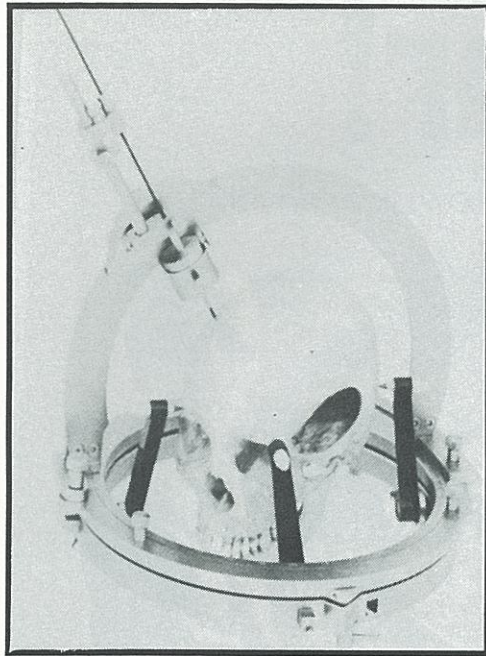
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**Figure 9.**  
The arc system in place on the headring

**Figure 10.**  
Simulation of surgery

four moveable angles (delta, beta, gamma, alpha). The arc is locked onto the headring. The arc is rotated to the area chosen on the scalp by the surgeon. This area is marked with a sterile marking pen. (Figure 9 above)

All four moveable parts on the arc are tightened. The arc is transferred to the phantom base and secured. Local anaesthesia will be infiltrated at this time.

The pointer is lined up with the sterile pointer on the phantom base. Scales on the phantom are read giving the entry point coordinates. These coordinates are transcribed onto the special paper with coordinates from the CAT scan.

### Data and the computer

With this information we are now ready to feed our data into the computer. All the X and Y coordinates from the CT scan are placed in by the surgeon. Coordinates are checked for any errors, and errors that have been corrected, if any. The computer is then run.

These co-ordinates give the target values to be set on the phantom base. The entry point coordinates are entered, checked, and computer run. After a few seconds the computer prints out the other information needed to do the surgery. This printout, will become part of the patient's chart. We are now

ready to simulate the surgery.

With the arc system locked onto the phantom base the target values from the printout will be set on the base, the four angle coordinates set on the arc, and the depth measured on the cannula. Cannula will be introduced. It will touch the top of the target within 1 mm. If cannula is off a distance greater than 1-2 mm then an error has been made. (Figure 10) The sequences just described are our surgeon's way of doing his surgery. There are other ways that the same can be accomplished.

### The surgery

After successful simulation, we are now ready to do the biopsy or aspiration on the patient. The arc is returned to the headring and locked into place. A small incision is made, drill is introduced and small entry is made into the cranium. (Figure 11)

The surgery is performed, specimens sent, area sutured closed and headring is removed. A small dressing is applied to area. The patient is taken to either P.A. or sent back to the ward, the final decision made by the anaesthetist and surgeon.

### Postoperative care plan

Postoperatively the patient should be closely

monitored for signs of increasing intracranial pressure which could be due to intracerebral bleeding or edema. Neurological and vital signs should be checked every ten minutes in the post anaesthesia care unit and then every fifteen minutes once the patient returns to the ward. If the neurological signs are stable after an hour, then the patient can be monitored every hour for four hours and progress to every four hours. The dressing should be observed for drainage. In order to promote venous drainage from the head and prevent intracranial pressure from rising, the head of the bed should be elevated 30°. The patient may experience mild incisional pain and can be medicated with analgesics.

There is also the potential for meningitis and the patient should be observed for signs of this such as nuchal rigidity, fever and chills, irritability and increased sensitivity to light. Patients can be up and about the same day and are usually discharged the following day.

**Experience at St. Boniface General Hospital  
Winnipeg, Manitoba, June, '86 - February, '87**  
13 cases performed  
12 cases were tumor biopsies.  
1 case was aspiration of an abscess.

### Summary of Cases

Lymphoma.....	3 .....	(23%)
Astrocytoma.....	7 .....	(53%)
No diagnosis.....	1 .....	(08%)
(Tumor was firm or difficult to obtain tissue from)		
Metastatic.....	1 .....	(87%)
Abscess.....	1 .....	(08%)

### Follow up cases

- Six patients resumed regular activities of life.
- Three patients independent but with a major or minor disability.
- One patient deteriorated, due to tumor progression.
- Three patients died as a result of original tumor: two patients lymphoma and one patient astrocytoma Grade IV.

### Disadvantages of stereotactic surgery

In spite of the advantages, stereotactic surgery does carry with it some disadvantages. Some of these can be overcome with practice and education:

#### 1. Heavy components

The phantom base is especially heavy requiring a portable trolley. Great care is needed in caring for this equipment and ensuring that nothing is dropped.

#### 2. ETO sterilization required

Because of the sterilization measures required, only one case can be done in a day.

#### 3. Potential contamination

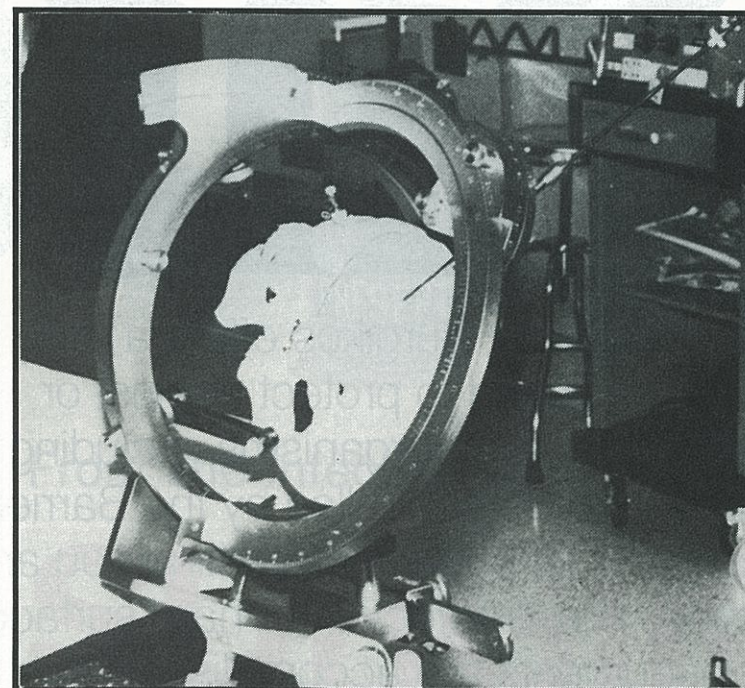
There is always the potential for contamination: transferring the sterile arc system from the headring to the phantom with the headring and phantom not being sterile, there is that chance. Great care is required by the surgeon and scrub nurse to maintain a sterile field. Meticulous technique is necessary from all staff.

#### 4. Emergency intubation

Emergency intubation would be difficult due to the placement of the headring in front of the oral airway.

#### 5. Long, fine instrumentation

Because most tumors are deep-seated, the need for long, fine instruments are necessary. Care and



**Figure 11.** After simulation, the system is ready for the surgery. Illustration above shows the drill to be used to make the entry into the cranium.

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handling is extremely important. Teaching is necessary for the staff working with and caring for this equipment to keep it in good working order.

#### 6. Transcription of coordinates

Last but not least is the accurate transcription of coordinates into the computer. All of us are human and mistakes can happen. That is why numbers are double checked. Small errors in transcription could lead to serious errors in the localization of the target point. As I said, education is the key, and some of these drawbacks can be avoided. (1)

#### Conclusion

This type of surgery opens new horizons in brain surgery for the neurosurgeon. With this modern technology, neurosurgeons are able to make a diagnosis for deep-seated, obscure lesions, and refine their treatment plan for their patients. Being a relatively new technique, it will contribute to new research studies at St. Boniface General Hospital.

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- 1) Goodman J., "State-of-the-Art Stereotactic Surgery," Contemporary Neurosurgery, Vol. 6., No. 19., 1984.
- 2) Heilbrun, Peter, M.D.; Roberts, Theodore S., M.D.; Apuzzo, Michael, L. J., M.D.; Wells, Trenth Jr., M.D.; and Sasshin, James K., M.D., "Preliminary experience with Brown, Robert, Wells (BRW), computerized tomography stereotactic guidance system." Neurosurgery, Volume 59, 1983.
- 3) Sawaya Raymond, M.D., "The Brown Robert Wells Stereotactic System in Management of Intracranial Lesions," Contemporary Neurosurgery, Volume 8, No. 12, 1986.
- 4) Care Plan - Pat Gregory, R.N. - Nurse Educator, Neuroscience, St. Boniface General Hospital, Winnipeg, Manitoba.

#### Acknowledgement:

Special thanks to Dr. Michael West, Neurosurgeon, St. Boniface General Hospital, for all his assistance.

# Calendar of Events...

**March 6 - 11, 1988, Dallas, Texas:** 35th Annual AORN Congress. (Contact Association of Operating Room Nurses, 10170 East Mississippi Ave., Denver, Colorado 80231 U.S.A.)

**March 30, 1988, Hamilton, Ontario:** Day in Orthopaedics, Hamilton Convention Centre. (Contact Programme in Continuing Medical Education, McMaster University, Rm. IM6, H.S.C., 1200 Main Street West, Hamilton, Ontario L8N 3Z5 (416) 529-9140 Ext. 2219).

**April 3, 1988, Hamilton, Ontario:** Surgery in the Elderly, Hamilton Convention Centre. (Contact Programme in Continuing Medical Education, McMaster University, Rm. IM6, H.S.C., 1200 Main Street West, Hamilton, Ontario L8N 3Z5 (416) 529-9140 Ext. 2219).

**April 16, 1988, Toronto, Ontario:** "Trauma Seminar for Operating Room Nurses," Toronto Convention Centre. (Sponsored by the Operating Room Nurses Association of Greater Toronto. Details and registration: Elizabeth Jones (616) 733-3054).

**May 30 - June 3, 1988, Vancouver, B.C.:** National Conference, Operating Room Nurses Association of Canada (ORNAC); B.C. Convention Centre and Pan Pacific Hotel. (Contact, for delegates, Mary Raikes-Tindle, 5199 Turquoise Drive., Richmond, B.C. V7C 4Z6. Conference Exhibitors, for details and registration, Jean Kerr, 1105 - 2050 Nelson St., Vancouver, B.C. V6G 1N6).

**October 21-21, 1988, Hamilton Area:** 4th Annual Regional Conference, Operating Room Nurses Association of Hamilton and District, Prudhommes Inn, Vineland Station & Queen Elizabeth Way. (Contact Gale Mitchell, Chairman, Program Committee, O.R.N.A.H. & D. (416) 648-8076).

### Future National Conferences O.R. Nurses Association of Canada

1988-Vancouver, B.C., May 30-June 3  
1990-Toronto, Ontario, April  
1991-Banff, Alberta, May  
1993-Province of Quebec

# Executive Nominations ORNAC 1988

Nominations have been received by the Nominating Committee of the Operating Room Nurses Association of Canada (ORNAC) for election to four ORNAC executive positions:

- President Elect**
- Vice-president**
- Secretary**
- Treasurer**

It should be noted that the incumbent president elect (Joan Donald, NB), assumes the position of president. Thus, there is no nominee and no direct election of the ORNAC president. Also, the incumbent president (Ann Robinson), assumes the position of past president.

Election of the four ORNAC executive members will be held on Sunday, May 29, 1988 during the ORNAC Board Meeting to be held at the Pan Pacific Hotel in Vancouver. This date coincides with the opening of the National ORNAC Conference slated to begin the following day, Monday, May 30th. Individuals nominated for the positions are:

- President Elect (1) -**
  - (1) Sylvia Humphries (NFLD.)
  - (2) Gloria Stevens (B.C.)
- Vice President (1) -** Carol Lenox (Ont.)
- Secretary (1) -** Muriel Shewchuk (AB)
- Treasurer (1) -** Carole Starr (Ont)

To be eligible for nomination and election to the ORNAC executive, the candidate, according to the Operating Room Nurses Association of Canada by-laws, must be...

- A perioperative nurse whose primary professional focus is...
- 1. Direct patient care during the intra-operative phase of surgical intervention until admission to P.A.R./P.A.C.U.

or

- 2. Administration of the surgical suite or
- 3. Involved in research pertaining to the intra-operative care of the surgical patient or
- 4. A teacher of skills to student nurses and/or staff in the intraoperative setting.
- A CNA member (mandatory)
- An ORNAC board member or committee member for a minimum of two years.
- An active member of a provincial operating room nurses organization.

## Nominee Profiles

### President Elect

(1) *Sylvia Humphries*



Nursing Unit Administrator, Operating Room, Western Memorial Hospital, Corner Brook, Newfoundland, Ms. Humphries has been in nursing continuously since graduating from the above hospital's School of Nursing. She is presently in her 3rd year of part-time studies for her Baccalaureate in Nursing. A founding president of the Newfoundland and Labrador Operating Room Nurses Association (N&LORNA), she has been a member of ORNAC's Board of Directors since the inception of the national organization in 1983. Between 1986 and 1988, she served on the ORNAC executive as vice-president.

Among her stated objectives for the Operating