Solo hand surgery

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Unassisted hand surgery is being undertaken by necessity for both elective and emergency cases, due to hospital resource restrictions. The authors outline the principles of local anesthesia, surgeon-controlled tourniquet techniques, and a number of new instruments which allow a surgeon to work in comfort and safety, unassisted. The traditional surgical instruments designed for the days when trained surgical assistants were available to hold them are no longer suitable. We are entering a new era of surgical design with safer instruments that can complement our skills rather than challenge them. There are significant cost savings and efficiency when hand procedures are undertaken in the emergency and outpatient clinic settings.

Key Words: *Anesthesia in hand surgery; CHESS system in hand surgery; Hemostasis in hand surgery; Magnetic hand retraction; Unassisted surgery*

Hand surgeons have traditionally carried out their craft in the secure sanctum of a main operating room with an anesthetist to manage the patient's general or regional anesthetic and with a pneumatic tourniquet. We have enjoyed the assistance of a scrub nurse and often a surgical assistant, and have been efficiently attended by a circulating nurse.

In this brave new world of hospital restructuring, 'serious surgery' (what general surgeons perform) has progressively husbanded the resources, leaving hand surgeons to fend for themselves in the outpatient or emergency department (1).

Gone is our scheduled access to an anesthetist and our trained and helpful assistants, including the circulating nurse, who found and organized all our instruments and dressings.

We are progressively being forced to become solo hand surgeons, and both our techniques and instruments must evolve to suit our requirements.

METHODS

Techniques

In hand surgery, the advent of the wrist tourniquet has allowed hemostasis to be achieved safely and reliably in an outpatient or emergency setting. It rivals the pneumatic tourniquet for efficacy, but holds the great advantage in that there is minimal patient discomfort, even when the patient is fully conscious and alert.

Une opération de la main en solo

Une opération non assistée de la main est entreprise par nécessité tant dans des cas non urgents qu'urgents, en raison des compressions aux ressources hospitalières. Les auteurs exposent les principes de l'anesthésie locale, les techniques de garrot contrôlées par le chirurgien et un certain nombre de nouveaux instruments qui permettent au chirurgien de travailler à l'aise et en sécurité, sans aide. Les instruments chirurgicaux classiques conçus pour l'époque où des assistants chirurgicaux étaient disponibles pour les tenir ne conviennent plus. S'ouvre une époque de conception chirurgicale où des instruments plus sécuritaires peuvent compléter nos aptitudes plutôt que les compliquer. D'importantes économies et une plus grande efficacité sont constatées lorsque des opérations de la main sont entreprises en urgence et en consultations externes.

Studies have shown that adequate pressures can be maintained for considerable time, certainly sufficient to perform most surgical procedures with satisfactory hemostasis and complete comfort for the patient (2).

A number 8-1/2 glove or a 1" Penrose drain can be wrapped about the wrist (Figure 1) circumferentially with a modest degree of force to provide blood flow interruption, at pressures of approximately 150 mmHg to 250 mmHg. The tourniquet can be secured with a simple towel clip or Kelly forceps, and can be applied and removed with ease by the surgeon.

Local and regional anesthesia can be readily accomplished by the surgeon. Median nerve blocks at the wrist, radial nerve blocks at the wrist or elbow, and ulnar nerve blocks at the elbow are easily learned and highly effective. In fact, xylocaine 2% with adrenaline blocks of the median nerve provided on average 6 h of clinical anesthesia in an ongoing study (3) of carpal tunnel surgery by one of the authors of the present paper (MSGB).

Instrumentation

With anesthesia and hemostasis requirements readily fulfilled, the issue of instruments needs to be addressed. Unfortunately, our standard familiar instrumentation was designed for the era when trained clinical assistants were available.

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Figure 1) The PalmSpring retractor (Canica Design, Canada) can be operated with one hand. The Penrose drain tourniquet is secured with forceps and can be applied and removed with ease by the surgeon

Performing solo hand surgery requires some form of self-retaining retractors. The current state of the art in wound retractors is unfit to meet this goal. The standard Holtzheimer retractor is a well-designed instrument, but much too small for the long and deep incisions required for proper visualization in a carpal tunnel release, or for flexor tendon exploration.

The Weitlander retractors are more suitable for general surgery. The retractor teeth are large and traumatic, and the instrument is, in fact, rather cumbersome when used for hand surgery.

Senn retractors, although commonly used, require an assistant. The unfortunate design of the sharp-teethed rake precludes safe utilization of the ribbon end for retraction in this era of transmissible hematogenous infections. The controlled positioning of the patient's fingers, so that they are not in the way when performing fracture reduction and nerve and tendon repairs, is also desirable. Without the proper instrumentation to display and control hand and finger position, the solo surgeon is truly a 'one-armed paper hanger'.

To solve this problem, the authors have worked in close conjunction with the design team from Canica Design (Canada) to develop self-retaining retraction instruments for hand surgery.

PalmSpring retractor (Canica Design, Canada)

The first product solution is a simple bow-like retractor, the PalmSpring, which can be operated with one hand (Figure 1). This replaces the bulky retractors with blunt tips which tend to slip and the sharp-tipped models which are traumatic and often too large for small incisions. When opened, the instrument produces a rectangular opening giving visualization of the proximal and distal ends of the incision, which is especially valuable in carpal tunnel releases. This allows remarkably short incisions (2.5 cm).

The adjustable spring design is superior to static ratchet designs in providing controlled pressure to achieve hemostasis as well as visualization over a wide distance. The fine blunt teeth provide exceptional grip at depth yet remain atraumatic. This device can be inserted and manipulated with one hand. The offset spring body maintains a clear field of vision. The additional benefit for the patient is a shorter incision for carpal tunnel surgery with less pain than is experienced with the traditional incision, especially at the wrist flexion crease. From

Figure 2) CANICA Hand Surgery System (Canica Design, Canada)

the surgeon's perspective, the PalmSpring offers reduced operating time, improved hemostasis with superior visualization and adjustment, at low cost.

CANICA Hand Surgery System (Canica Design, Canada)

The most versatile and comprehensive retraction system available for hand surgery is the CANICA Hand Surgery System (CHESS).

The secret behind CHESS is the use of strong rare earth magnets built into component bases to achieve stable fixation while effectively containing the magnetic flux fields. Therefore, the magnetic field has no influence on instruments, patient or operator (4). The magnets will withstand repeated autoclaving cycles (with a maximum working temperature of 151°C) without loss of strength.

The surgeon can move and leave a component under tension using the magnetic field, avoiding the use of locking or latching mechanisms. This is performed with precision and ease (Figure 2).

Surgical technique: The hand is laid on a ferromagnetic stainless steel base plate covered with a sterile towel, and the magnetic CHESS components are then positioned to immobilize the hand and individual digits as needed. The CHESS Bridge can be used to tilt the hand in flexion and extension positions facilitating nerve and tendon repair (Figure 2).

CHESS can provide either static or dynamic retraction forces up to 800 g. Static retraction is constant but adjustable by repositioning the attached magnetic component. Dynamic traction is achieved by applying silicone elastomers to the retractors and anchoring the elastomers to a static magnetic base. This dynamic traction can be maintained as a nearly constant force; eg, as an incision is extended, the wound edges are simultaneously further retracted. This is ideal for incision retraction avoiding repositioning or minor manipulation. The hand or fingers can be rotated with the retraction maintained, ideal for arthroplasties and ligament and tendon repairs.

The CHESS system simplifies immobilization of both the hand and individual digits, providing atraumatic three-dimensional control (Figure 2). The precision atraumatic retractor design makes the system especially useful for pediatric and microscopic surgical procedures (Figures 3 and 4), which

Figure 3) *Dynamic microhook traction pulling proximal median nerve into alignment for microanastomosis*

show a microhook aligning a median nerve for repair. The dynamic traction removes all tension or distortion on the repair, allowing a precise anatomical anastomosis.

Both CHESS and PalmSpring surgical instruments have been used routinely for over three years by the senior author (MSG) in a wide spectrum of different hand and upper limb operative procedures.

CONCLUSIONS

Hand surgery, both elective and post-traumatic, is being performed with greater frequency and with less cost on an outpatient basis. Clinical outcomes and safety are equivalent to those for surgical treatment performed in main operating theatres (1).

The described new surgical instruments, both PalmSpring and CHESS, have introduced a new level of direct control in hand surgery for the solo surgeon, which contributes to overall quality and safety, and reduced procedure time.

Figure 4) *Postmedial nerve repair showing nerve microhook and silicone elastomer*

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