Transformations
ISSN 1444-3775

2007 Issue No. 15 — Walter Benjamin and the Virtual

Cybersurgery and Surgical (Dis)embodiment: Technology, Science, Art and the Body

By *Julie Doyle*

> The magician heals a sick person by the laying on of hands; the surgeon cuts into the patient's body. The magician maintains the natural distance between the patient and himself.…The surgeon does exactly the reverse; he greatly diminishes the distance between himself and the patient by penetrating into the patient's body and increases it but little by the caution with which his hand moves among the organs. (Benjamin 227)

In *The Work of Art* essay, Benjamin deploys the analogy of the magician and surgeon to illustrate the different ways the painter (magician) and cameraman (surgeon) technologically mediate and alter our perception of reality. The cameraman's use of the camera refigures reality by penetrating and re-presenting it as "multiple fragments which are assembled under a new law" (227). This is unlike that of the painter, whose "natural distance from reality," enables the picture to be "a total one," but one which is of less significance to the "contemporary man [sic]," because of the "thoroughgoing permeation of reality with mechanical equipment" (227). The fragmented filmic images, diminishing the distance between viewer and object, are more "real" than the total image of the painter's. Imaging technologies alter human perception and constitute a new real.

Surgical interventions likewise alter perceptions of the body. The surgical scalpel instantiates a fractured body view; "by penetrating into the patient's body," it becomes understood through its constituent parts (Benjamin 227). Benjamin's use of the surgeon to illustrate how technological mediation contributes a new reality is a radical, but under examined, evaluation of the mediated status of the body within science [1]. By choosing the surgical penetration of the body to represent this mediated reality, Benjamin inadvertently highlights the specific interventions of surgery in modern conceptions of the body. However, in contrast to Benjamin's positive interpretation of filmic reality, in the context of medical science, the result is the fragmentation of the body through the medicalised focus upon isolated anatomical parts, at the expense of the whole (Young; Wegenstein). Modern conceptions of embodiment have been constituted through the body's figuration as subject/object, embodied/disembodied.

The surgical penetration of the body anticipates the current use of virtual technologies in surgery. Cybersurgery (or computer aided robotic surgery) utilises digital imaging and robotic technologies to perform surgery remotely. Here, the surgeon does not directly touch or see the patient's body but is seated at a computer console away from the patient's body (Fig. 1). Via 3D stereoscopic digital images, the surgeon manipulates the robotic arms from the console to carry out the surgery. Positioned over the patient's body, the robotic arms contain an endoscopic camera and surgical tools. Digital imaging and (computer manipulated) surgical technologies penetrate and mediate the body, presenting an *image* of the fragmented body to the surgeon through which the *material* practice of surgery is remotely performed.

Fig. 1 The surgeon sits at the console and manipulates the robotic arms in the background. ©*2007 Intuitive Surgical, Inc.*

This paper re-examines Benjamin's understanding of the technological mediation of reality presented in his Work of Art essay, in specific relation to the surgical mediation of the body. Focusing upon the history of surgery in Britain in the late eighteenth/early nineteenth centuries, and its relationship to current surgical practices, the paper demonstrates Benjamin's relevancy in understanding contemporary mediations of the body through the lens of surgical technologies [2]. Firstly, it calls attention to the historical role of the surgeon in the formation of an anatomical conception of the body, mediated through imaging and surgical technologies. Secondly, the relationship between these technologies is examined in current surgical practices, reliant upon the digitised image of the body (in parts) for surgical practice. Thus, I am concerned with how, as Esther Leslie explains of Benjamin's work, "the past reverberates in the present; the present filters the image of the past" (Leslie x).

Benjamin believed in the revolutionary potential of imaging technologies for the masses. This paper argues, however, that in the context of surgery, technologies fragment the body and prioritise its image over an embodied reality. Benjamin's assertion that the painter (magician) and cameraman (surgeon) offer different versions of reality is also critiqued by showing the connections between surgery and art/aesthetics in the (historical) mediation of the body. Benjamin was concerned with acknowledging how technology alters human perception within cultural, historical and political contexts. This paper seeks ultimately to re-embody the body by calling attention to the technological, cultural and political processes which underpin the practice of surgery. It thus shows the continuing importance of Benjamin in understanding and critiquing the surgical mediation and treatment of the body in (late)modernity and in the (dis)embodied practices of (cyber)surgery.

The Work of Art essay: History, technology, perception

> During long periods of history, the mode of human sense perception changes with humanity's entire mode of existence. (Benjamin 216)

Benjamin's Work of Art essay examines changes to the social function of art as a result of technical reproduction, namely art's decline in "aura" [3]. Aura relates to the art work's "presence in time and space, its unique existence at the place where it happens to be" (214), e.g. a statue in a temple. Art's uniqueness constitutes its "ritual function" (217) or "cult value" (218), where the meaning of the art is derived from historical and social relations, either religious or secular. Both create a distancing effect between the viewer and the art work through ideals such as "creativity and genius, eternal value and mystery" (212) endowed upon the art work and its author. The ability to technically reproduce a work of art and place the copy "into situations which would be out of

reach for the original itself" (214/215), rids the artwork of its ritual function, and replaces this with "exhibition value" (218). The communicative value of the artwork thus supplants the ritualised and distant contemplation of art.

Revolution, Benjamin argues, is achieved as a result of the withering of the bourgeois concept of aura premised upon "a narcissistic ideology" (Leslie 150) of tradition and individuality, enabling the emergence of a political art through the democratising potential of photography and film. Through the *technological* alteration of human *perception*, a new social order can thus be formed. However, Benjamin's Work of Art essay is also ambivalent about the revolutionary potential of these new imaging technologies, demonstrated by reference to the Fascist "introduction of aesthetics into political life" (Benjamin 234), which fetishises technology for the services of war, leading to mass "self-alienation" (235) [4].

Benjamin asserts that imaging technologies change cultural perceptions. Change is not just brought about by what the technology does, but also how it is produced and used within a set of relations, that are capitalist and class based. In film we can see how camera technology changes *visual* perception, as "a different nature opens itself to the camera than opens to the naked eye" (230), expanding and altering the field of vision, revealing "entirely new structural relations of the subject" (230) . The camera's ability to focus in, do close ups and slow time reveals a different reality to the viewer. Benjamin's claim that "[T]he camera introduces us to unconscious optics as does psychoanalysis to unconscious impulses" (230), illustrates the primary role of the image and seeing within a technologically mediated culture. Benjamin thus attributes these changes to human perception through the primary sense of sight, and its relationship to images/imaging.

Other human senses are changed through the experience of shock. Thus, "the painting invites the spectator to contemplation; before it the spectator can abandon himself to his associations. Before the movie frame he cannot do so. No sooner has his eye grasped a scene than it is already changed" (231). It is the constant changing nature of the filmic image that interrupts the "spectator's process of association" (231), which "constitutes the shock effect of the film" (232). Shock is experienced physiologically through a disruption of norms. Whilst the technologically (re)produced image alters perception, Benjamin also demonstrates how such change is also always tactile.

> For the tasks which face the human apparatus of perception at the turning points of history cannot be solved by optical means, that is, by contemplation, alone. They are mastered gradually by habit, under the guidance of tactile appropriation. (233)

In acknowledging sight and tactility as part of the changes to human perception, Benjamin argues for an embodied experience of technology, foregrounding the intimate relationship between imaging technologies, bodies and human sensory perception in relation to their historical and social shaping.

Rather than figuring technology as acting on bodies, Benjamin presents technology as working through bodies, intervening in the thoughts, actions, sights, sounds, and touch of humans. Benjamin asks art "to undo the alienation of the corporeal sensorium, to restore the instinctual power of the human bodily senses for the sake of humanity's self preservation, and to do this, not by avoiding the new technologies, but by passing through them" (Buck-Morss 5). This represents a radical understanding of technology's role in conceptions of embodiment and subjectivity. Weigel traces the body through a range of Benjamin's writings, highlighting the role images play in Benjamin's understanding of perception: "The images of our perceptions and ideas, and the metaphors with which we are surrounded, are seen by Benjamin as 'body-and image-space' (*Leib- und Bildraum*) in which our reality is engendered" (Weigel x). Here, "the primary mode and primary material of thought and ideas are images" (4) handed down historically. Although Benjamin offers an understanding of perception beyond sight, to include tactility, it is important to acknowledge the primacy he gives to the image/imaging within human

perception/embodiment.

This paper now moves on to examine the relationship between technologies and the body. It explores connections between history, technology, image/imaging, perception, sight and tactility, as identified in Benjamin's Work of Art essay, in order to trace the historical development of modern conceptions of the body through surgery.

The surgeon as anatomist/scientist/artist: Historical discourses of the body

> It may not be improper to remark that, Anatomy and Surgery, being sister arts, it is evident that any improvements in the one, must have been attended with some advantages to the other. (Justamond 52)

The discourse of anatomy as a science was a specific development of the late eighteenth and early nineteenth centuries, promoted by surgeons as representative of their profession as scientific. However, physicians were the elite of the UK medical establishment, receiving their medical education at the Universities of Oxford and Cambridge (Robb-Smith), and regarded as book learned, respectable medical men. In contrast, surgeons were inferior because of their "hands-on" approach to the body and their lack of university training. Physicians rarely touched a patient's body; the practice of physic was internal medicine where disease was diagnosed according to an elaborate classificatory system, reading external symptoms, unaided by instruments, as evidence of a range of possible internal diseases. Surgeons, on the other hand, had an intimate connection with the body's physicality. Working with hands signified a manual lowly craft, whereas physic represented the use of intellect.

The words "surgery" and "surgeon" come from "*chirurgia* which is derived from the Greek words, *cherios*, meaning hand, and *ourgia*, meaning action. Thus, a surgeon acts with his hands" (Katz 32). Given the association of manual skills with lowly forms of craft, surgeons resignified their actions as scientific through the promotion of anatomy and dissection as scientific endeavours. Cutting the dead body to extract its "truths" required considerable proselytisation by surgeons in order to assuage public concern about dissection, but more importantly, to intervene within existing medical hierarchy as credible practitioners.

> A comparatively general knowledge of the anatomy of the human body may be sufficient for a Physician.…The rest it will be enough for him to have seen repeatedly dissected. But the hands of the Surgeon must be constantly employed in this work. He ought to bare every part of this complicated machine, and all the relative situations of each, as accurately in his mind, as the painter or the sculptor should its outline and general proportions. (Chevalier, *Observations in defence* 67)

Surgeons' reasoning of the practical aspect of anatomy involved a figuration of scientific knowledge as attainable through *observation* of the anatomical structures of the body: observation that required the surgeon's skills to reveal these "truths" through the *mediating actions* of the surgical knife and "his" hands.

Skills such as judgement and perception were also promoted as part of the surgeon's character. In 1801, the surgeon Chevalier stated that, "though manual operation is that by which surgery is chiefly distinguished from Physic, operation itself, considered as a mere mechanical act, is only a small part, and that by no means the most difficult of the surgeon's art" (*Introduction to a course* 3). Chevalier foregrounds judgement about "the moment when the knife should be employed." Furthermore, "a sound understanding, a keen eye, a steady hand, and an intrepid mind, are qualifications of great importance" (5). The hands, eyes and mind of the surgeon were intimately entwined in surgical skills. Surgeons did not deny the fact that hands were involved in surgery, as this would undermine their practices, rather they presented these skills as linked to the exercise of

the surgeon's mind, elevating their skills as not only equal, but superior, to those of the gentlemanly physician.

The promotion of anatomy and surgery as a science was aided by the use of images of the anatomised body. Anatomical atlases had a long history within medical science, with Vesalius's famous text, *De Humani Corporis Fabrica* (1543), inaugurating the production of "scientific" anatomical texts. Yet, it was not until the mid to late eighteenth century that anatomical illustrations began to signify as unmediated signs of anatomic knowledge, taken as first hand knowledge rather than second order representations (McGrath). In 1774, the surgeon-anatomist William Hunter published a collection of engravings of the (dead) pregnant female body in his atlas, *Anatomy of the Human Gravid Uterus* (1774). This atlas was instrumental in placing anatomical illustrations, and (female) anatomy, as central to scientific knowledge, based upon the visible "evidence" shown by the anatomical structures (Doyle; McGrath) [5].

Surgeons often intervened in the imaging processes, blurring boundaries between surgeon and artist. The "father" of British surgery, William Cheselden, bore witness to these convergences in his surgical text, *Osteographia, or the Anatomy of the Bones* (1733). The titlepage (Fig 2.) depicts the use of the *camera obscura* as a mediating process within anatomical illustration. Giving credit to the work of his engravers, Cheselden declared his own involvement in the image production, in the posing of the bodies to be illustrated, but "sometimes in the drawings with the pencil, and often with the needle upon the copper plate" for "where the anatomist does not take care, he will scarce have his work well performed" (Cheselden, preface).

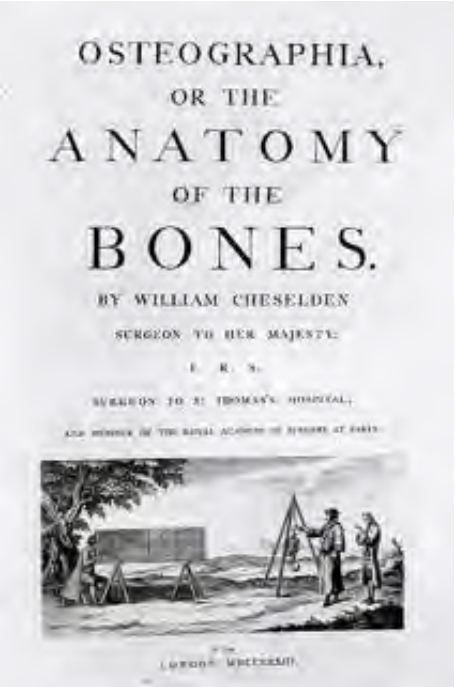
OSTEOGRAPHIA,
OR THE
ANATOMY
OF THE
BONES.
BY WILLIAM CHESELDEN
SURGEON TO HER MAJESTY:

Fig 2. Cheselden's surgical text, demonstrating the use of the *camera obscura* for anatomical illustration and surgical knowledge, 1733. © Wellcome Trust, London.

Eighteenth and nineteenth century surgeons were actively involved in the body's inscription as an empirical, anatomical form. Over the course of the nineteenth century, illness and disease were relocated to the anatomical structures of the body, redefined as surgically treatable. Anatomical

discourse and surgical practice went hand in hand. As Katherine Young says, "Surgery constitutes a defamiliarisation of the body. The discourse of anatomy inscribes the body as an assemblage of objects" (100). The dominance of this figuration with modern conceptions of embodiment is testimony to the earlier work of surgeons who elevated their practice from lowly craft to elite scientific profession by the late nineteenth century. This was aided by the creation of a Royal College of Surgeons of London in 1800 and the passing of the Anatomy Act in 1832 which legally enabled surgeons to use unclaimed paupers' bodies for dissection (Richardson). As anaesthesia (from 1846) and antisepsis (from 1867) were introduced, more dramatic open surgery such as abdominal surgery took place, contributing to the more familiar image of the surgeon as hero, rather than barbaric dissector (Katz).

Surgery's history reveals how the body has become figured as an anatomical object – a "body-in-pieces" (Wegenstein 9) – as a result of a series of mediations, involving dissection, anatomical images, and the surgeons' rhetoric promoting the skills of hands (action), eyes (looking) and mind (perception/judgement). In sympathy with Benjamin's concern with "the development of the human sensorium" (Leslie 150), these skills call upon all of the senses. The surgeons' proselytisation of their skills was dependent upon promotion of the tactility of their practice – their hands on approach. Yet, it is the cultural denigration of hands and tactility as the signification of manual craft, rather than science and/or art, that made surgeons appeal to a Benjaminian discourse of auratic art in order to elevate their profession to one that involved contemplation, creativity and genius – those "outmoded concepts" (Benjamin 212).

But what effect have more recent surgical practices had upon conceptions of the body in late modernity? The expansion of digital imaging technologies in the realm of anatomy and surgery have impacted upon surgical training and practice. How does Benjamin's investment in the materiality of technology and its aiding of human sense perception get played out in contemporary surgical practice? I will now move on to examine the impact of digital imaging technologies, emergent from the 1970s, upon contemporary surgery.

From mechanical operation to digital visualisation: Minimally invasive surgery and virtual anatomies

Imaging technologies that visualise the interior human body without cutting into it have been instrumental in the changing practices of surgery. Since the early 1970s, developments in electronic/digital imaging technologies have contributed to minimally invasive surgical techniques. Following the adoption of X-ray within late nineteenth century medicine, endoscopes were one of the first technologies to observe the interior of the living body without cutting into it. An endoscope comprises a flexible tube, a light source and a lens to view internal anatomy. However, it was not until the development of fibre optics in the 1950s that endoscopy was used widely in medicine. The introduction of a surgical instrument into the endoscopic tube enabled the performance of laparoscopic cholecystectomy (gall bladder removal) in 1987 (Lafranco et al; Darzi) and the first application of minimally invasive surgery.

Ultrasound and CT (Computerised Axial Tomography) imaging technologies were introduced in the early 1970s, and MRI (Magnetic Resonance Imaging) in the 1980s. CT and MRI translate numerical data into an image via a computer. Kelly Joyce explains that MRI was originally termed nuclear magnetic resonance (NMR), with measured nuclear frequencies translated into graphical data. The decision to transform data into images, and rename the technology MRI, was cultural, attributed to the "turn towards visualisation" during the 1970s with the proliferation of imaging technologies, such as computers, cameras and videogames (Joyce 3).

Picturing the interiority of the living human body, without cutting into it, represents a radical shift from pre-twentieth century anatomical images of dissected cadavers. CT and MRI body scans are now routinely reconfigured into 3D virtual anatomic images for use in anatomical

teaching and surgical training. In the early 1990s, the University of Washington's Structural Informatics Group launched The Digital Anatomist Project; a 3D interactive digital anatomical atlas comprising CT, MRI and simulated images (Fig. 3). The interior of the human body can be inspected virtually from multiple and fragmented viewpoints, aided by the vast amount of data produced by the US National Library of Medicine's Visible Human Project [6]. As the media theorist Bernadette Wegenstein comments, the interior body has been recorded and externalised. However, it is clear that the nature of such recording raises questions about what relation these virtual images have to the "real" body, the highly coloured simulations looking more like art work than human tissue.

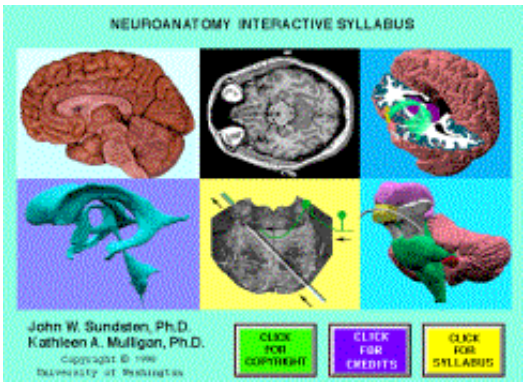

Fig. 3 Digital Anatomical Atlas. © University of Washington

Increased use of digital media has generated considerable debate within the medical professions (Jastrow and Hollinderbäumer). 200 years ago, arguments were waged between surgeons and physicians over the necessity of dissection for acquiring anatomical knowledge. Today, discussions consider the merits of learning anatomy from computerised images, compared with traditional cadaveric dissection. Central to these debates is the function of sight and touch as forms of sensory experience/knowledge. Following UK medical education reform in the 1990s, less time is now being given to the teaching of anatomy to undergraduate students (McKeown et al). The use of 3D digital imaging and interactive simulations provides an "efficient distribution of anatomical knowledge" (James et al 685), alleviating the expense and ethical implications of dissection (McLachlan et al). Others argue for the necessity of dissection to establish the primacy of the patient and mortality. Aziz et al contend that "Actual dissection is a journey into the body and, by touch, the student develops a synaesthetic map of human structural organisation" (25). The sense of touch is a necessary attribute of the surgeon; a sense missing in virtual anatomies.

Those in favour of cadaveric dissection maintain that dissection provides a real experience of the body. Those in favour of computerised 3D images contend that dissection does not deal with a real body as it is not living. I would argue that *all* anatomy is mediated knowledge. At stake though are the kinds of knowledges generated by virtual images and their impacts upon the learner/users. Anatomic images navigated in cyberspace privilege vision/visualisation in the acquisition of knowledge, mediated through a flat screen with restricted depth (Stoyanov et al). Benjamin's Work of Art essay would support a critique of this visual prioritisation at the expense of the tactile. As Esther Leslie argues, "Benjamin's re-evaluation of 'aesthesis' insists on tactility, the haptic, as part of the new techno-enhanced perception" (Leslie 151). Without the haptic, a restricted understanding of the body's materiality is promoted, which may impact upon the surgeon's approach to the patient. The consequences of such images could thus be further disembodiment of the surgeon, and a distancing, from the material body operated upon in surgery.

Cybersurgery and technological fetishism

> The surgeon of tomorrow will certainly explore new frontiers, visit inaccessible parts of the human body and operate where no man (sic) has gone before as a result of surgeons and engineers working more closely with each other than ever before to exploit the possibilities of technology. (Ellis 253)

Digital technologies have recently aided the development of robotic surgery, referred to (disturbingly) as master-slave systems, with the surgeon as the operator (master) and the robot (as the slave) performing the operation (Purkayastha et al; Rockall and Darzi; Lanfranco et al). The drive for research into surgical robotics came from the concept of telepresence, when NASA scientists joined forces with a team at Stanford Research Institute (SRI) in the early 1990s to develop the technology. The US army subsequently funded this research, with the intention of using telesurgery to operate remotely on wounded soldiers in war zones (Lanfranco et al). The technology, however, has never been used for these purposes. Instead, robotic surgical systems have developed in response to the visual, tactile and ergonomic limitations presented by minimally invasive techniques such as endoscopic surgery (Lanfranco et al; Purkayastha et al; Rockall and Darzi).

Endoscopic surgery requires the development of different hand-eye co-ordination than that used in open surgery.

> Moving the laparoscopic instruments while watching a 2-dimensional video monitor is somewhat counterintuitive. One must move the instrument in the opposite direction for the desired target on the monitor to interact with the site of interest. Hand-eye co-ordination is therefore compromised. (Lanfarnco et al 15)

The reverse movements required for the performance of the operation call upon a different sense perception and co-ordination. Introduced into surgery in the 1970s, the use of the endoscope could be likened to Benjamin's discussion of the defamiliarisation brought about by the filmic image, because the endoscope promotes counterintuitive movements. A double form of defamiliarisation takes place, firstly through the operation being performed upon the screened body image, and secondly, by the hands working in opposite direction to what the eyes see on the screen.

Robotic surgery is intended to ameliorate these limitations through technologies that work intuitively in response to the actual hand-eye movements of the surgeon (Darzi and Mackay), and have been in development since 1994, "as a result of new technology in lenses, cameras and computer software" (Purkayastha et al 153). Although "robotic surgery is still in its infancy" (Lanfranco et al), currently there are 2 commercially available robotic devices: the *da Vinci*™ robot (Intuitive Surgical, California, USA) and the *Zeus*™ robot (Computer Motion, California, USA) [7]. Both systems comprise of a console, endoscopic cameras and robotic arms (Rockall and Darzi). The console is placed at a distance from the operating table, connected by a cable to the robot. In the *da Vinci* system the robotic arms are mounted onto the mobile surgical cart (Fig. 4). The *Zeus* system "differs in that it has three separate arms that attach independently to the operating table" (Rockall and Darzi 642). Emerging discourses of robotic surgery foreground the system's technological capabilities, presented as improvements upon, and extensions of, surgeons' existing surgical skills. Eyes and hands, or vision and manual dexterity, are identified as the skills enhanced by these technologies.

Fig. 4. *da Vinci*™surgical cart. The robotic arms contain the endoscopic camera and a range of surgical instruments. ©*2007 Intuitive Surgical, Inc.*

The *da Vinci* system provides a 3D image of the operative field, delivering separate images to the left and right eye of the surgeon in the console from the same endoscopic camera on the robotic arms. The surgeon is immersed in the visual field of the operation. The surgeon manually manipulates the *imaged* body and the *imaged* tools (Fig. 5), performing the surgical procedure "without directly visualising or touching the organ being operated on" (Mack). The *da Vinci* system provides "visualization of the target anatomy unlike that ever experienced, with natural depth-of-field, enhanced contrast and magnification for more accurate tissue identification and tissue layer differentiation" (Intuitive Surgical). The technology also claims to take "surgery beyond the limits of the human hand" through the use of Endowrist™ Instruments which provide 7 degrees freedom of movement (Intuitive Surgical). Visualisation and dexterity better than human capabilities are the technological claims.

Emergent discourses of robotic surgery are largely celebratory. Michael Mack proclaims that "the technology is here, the potential is enormous, and the path is minimal." Whilst others may employ less euphoric language, most of the literature is positive (Rockall and Darzi; Hance et al). This fetishisation of technology, when read in relation to the terminology – the master-slave system – invokes Benjamin's concerns about a Fascist appropriation of technology. Obviously, the current exponents of robotic surgery are not advocating this for combative purposes (although the technology did emerge from US army research into remote surgery for use in war zones), and I don't mean to suggest this. However, the colonial terms used to describe the technology, and the euphoria which has accompanied it, does raise questions about the power relations through which this technology has developed and is being used – central to a Benjaminian critique. An extremely expensive system, it limits potential users, creating stronger links between companies that produce the equipment and hospitals/private clinics that use the technology.

There are significant disadvantages to the technology, specifically the loss of touch: "current telemanipulators have a complete lack of haptics or force feedback, with the operator *entirely dependent upon the visual image provided*" (Hance et al 8, my emphasis). The fetishisation of optics which Benjamin critiques finds its current realisation. As Benjamin says "the tasks which face the human apparatus of perception at the turning points of history cannot be solved by optical means, that is, by contemplation alone. They are mastered gradually by habit, under the guidance of tactile appropriation" (Benjamin 233). The loss of haptics within current surgical technology and practice is a significant development that illustrates surgery's historical changes, but also its continuing traces. In order for eighteenth/nineteenth century surgeons to make surgery scientific,

they had to resignify the body, and surgeons' "hands-on" relationship to this, as scientific. Concurrently, they also deflected attention away from the manual aspects of surgery by

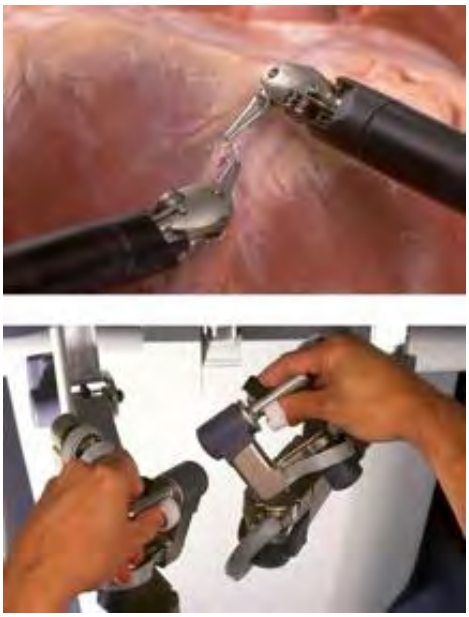

Fig. 5 The visual field presented in the console and the manual robotic arm controls. *©2007 Intuitive Surgical, Inc.*

extolling other skills, such as judgment, a keen eye and an intrepid mind (Chevalier). In current robotic surgery, visualisation becomes privileged, usurping the skills of the hand. Furthermore, the complete technological mediation of the surgical operation, including the patient's and surgeon's body, signifies a shift in surgical practice, where the surgeon operates upon an image. The image's paramountcy is demonstrated by the most recent developments in robotics for cardiothoracic surgery; beating heart surgery. This involves 'tricking' the surgeon's eyes and brain into believing that the heart is not beating. A still image of the heart is delivered to the screen in the console, whilst the surgery is performed upon the actual beating heart (Darzi; Purkayasta et al).

The imaged body in robotic surgery demonstrates Wegenstein's assertion that whilst the body has always been mediated, the medium has become the body: "notions of body and image have come together in what can be called an epistemological shift from a body emphasis to a medium emphasis" (Wegenstein 119). This takes Benjamin's exploration of the technological mediation of reality a step further. Whilst Benjamin was clear that (imaging) technologies mediate reality and alter perception, he was equally invested in examining the social and political relations through which these are produced and enacted. The technological euphoria that accompanies robotic surgery however, prioritises the medium, as anxiety over the loss of touch is superceded by the technological sophistication and superior visualisation promised. Yet this superiority does not relegate the surgeon to inferiority, for as the master-slave terminology suggests, the surgeon articulates *his* mastery of the technology, and of the body, through a colonial and masculinist discourse of power.

The surgeon's immersion in the 3D visual field of robotic surgery requires different visuospatial skills than open surgery, although training programmes are still in their infancy (Hance et al). Simulations, however, are already used for the training of laparoscopic surgery (Hance et al). The skills required in virtual laparoscopic surgery simulators are compared to those used for computer gaming, with students who play computer games "11% more efficient than those who did not play computer games" (Enochsson et al 878). Significantly, gender differences were

identified, as "the majority of students in the PC gamer group were men" (879). These findings raise questions about the gendered nature of surgical practice; a masculinist profession still dominated by men (Katz; Pringle; Cassell). Indeed, in order to understand the contemporary status of the body within surgery, the social and cultural context of the profession and its practitioners needs examining. As surgeons move closer into the body, they also move further away from it, where the medium – the technologies mediating the body – threatens to supplant the body itself (Wegenstein).

Conclusion

> The manner in which human sense perception is organised, the medium in which it is accomplished, is determined not only by nature but by historical circumstances as well. (Benjamin 216)
>
> Benjamin's comprehension of materialism is literal. It acknowledges the materiality of bodies, and the materiality of the culture they produce and consume – and also the historical nature of sensuous perception. (Leslie 161)

Benjamin's exploration of the effects of the technological reproduction of images and camera technology upon human perception have provided a means of analysing how the body has been historically mediated by mechanical, and now digital, technologies. The body has been shown to be mediated by both imaging and surgical technologies in the very construction of anatomic knowledge and in the practices of surgery. Benjamin's use of the surgeon (cameraman) to illustrate the technological mediation of reality has thus proven to be an astute insight into the way in which the body has become increasingly technologically penetrated. Yet, whilst Benjamin believed in the revolutionary potential of new technologies to alter human perception, and to "undo the alienation of the corporeal sensorium" (Buck-Morss 5), I have argued that this has not been the case with current surgical technologies and practice. The ever more thorough digital penetration of the body, bringing the body closer to the surgeon, means that the body becomes more fragmented and disembodied; an image on a flat screen, rather than a whole, three-dimensional, material body. Recent developments in robotic surgery call upon the imaginative capacities of the surgeon to equate the 3D digital image on the screen – which may "trick" the surgeon's brain as in beating heart surgery – with the whole human body on the operating table. Wegenstein believes there has been an epistemological shift, what Benjamin would call "a new law" (227), where the image and the body have fused together so that the medium is now the body. If so, then it is more necessary than ever to be attentive to the kinds of mediations that are occurring within surgery, and to interpret these within the social, cultural and historical context from which they emerge, as Benjamin would propose. Thus, whose understanding of embodiment is being presented as the norm?

Julie Doyle is a Principal Lecturer in Media and Communication Studies at the University of Brighton, UK. Her research interests include surgery and (gendered) embodiment, and environmental politics and climate change communication. She has published in journals such as *Science as Culture*, *Social Semiotics* and *Women: A Cultural Review*, and in edited collections such as Booth & Flanagan (eds), *Reload: Rethinking Women & Cyberculture* (MIT Press, 2002) and Dobrin & Morey (eds) *Ecosee: Image, Rhetoric, and Nature* (SUNY Press, forthcoming 2008). She is currently working on a project examining the mediation of climate change. j.doyle@brighton.ac.uk

Acknowledgements

My thanks go to the two anonymous journal reviewers for their insightful comments

on an earlier draft. Thanks also to Irmi Karl for her comments on the paper.

Endnotes

1. Susan Buck-Morss's essay, "Aesthetics and Anesthesia" (1992), deals with the practice of surgery in the nineteenth century through an exploration of the physiological nature of the human senses and the technical numbing of these senses through anaesthesia. Buck-Morss explores this historical relation in order to highlight the important role of the senses in Benjamin's call for art to restore the corporeal sensorium. I will make reference to her work later in the paper.
2. Whilst the historical focus is predominantly upon the development of surgery in the UK, my analysis of current surgical technologies and practices also draws upon developments in the US. This reflects the international development of current surgical technologies and practices, which include collaborations beyond national boundaries.
3. The version of the essay I am referring to is the third German version that was translated into English, and is published in *Illuminations* (1992). Esther Leslie (2000) discusses the various changes made to the versions, which included the removal of direct references to Marxism by the supervisor assigned by the Institute for Social Research to help Benjamin prepare the manuscript for translation. Whilst Benjamin's title was translated into "The Work of Art in the Age of Mechanical Reproduction," Leslie argues that a direct translation would be, "The Work of Art in the Age of its Technological Reproducibility." Taking the literal translation would change the "perceptual parameters" for the interpretation of the essay; rather than "the limited notion of mechanical…the idea of reproducibility shifts the emphasis of the essay onto a study of the impact of reproduction on all forms of art and creative practice, once those technologies that make mass reproduction a possibility or potential have been developed" (Leslie 132). This, Leslie argues, would be more in line with Benjamin's concerns with *Technik*, that is, with technology and technique that is concerned not only with the material hardware of technology, but also the "social and political relationships between producers and means of production" (xii). In my reading of Benjamin's essay, and in my reading of surgical practice, I follow Leslie's understanding of Benjamin's work and am thus concerned with the ways in which material technologies are embedded within social relations, and through which these technologies are produced and used.
4. For an excellent exploration of the ambivalences and contradictions presented by Benjamin's account of the aura, see Miriam Hansen 1987.
5. Elsewhere, I have looked in more detail at the historical rise of surgery in relation to the formation of an anatomically differentiated/fragmented conception of the body. The relation between surgery and anatomy has had implications for the ways in which sexual difference gets inscribed through an anatomical narrative. See Doyle 2007.
6. Inaugurated in 1993, the goal of the US National Library of Medicine's Visible Human Project was the "creation of complete, anatomically detailed, three-dimensional representations of the normal male and female human bodies" using a male and female cadaver (VHP). The female and male bodies were dissected and then imaged at one millimetre (for the male) and 3 millimetre (for the female) cross sectional intervals, employing magnetic resonance imaging, digitised computer tomography as well as photographic images. The data is available for purchase and has been reconfigured into a variety of computerised 3D images and virtual animations, including fly-through animated tours of the male body. The project has been discussed by a number of cultural and feminist theorists, in particular with regards to the normalcy engendered in the project. See Treichler et al. 1998.
7. It is interesting to note here the choice of names for these systems. Da Vinci is a conscious

link to a history of anatomical imaging and art; whilst the Greek myth of Zeus, Father of the Gods, links with the heroic masculine image of the surgeon as the elite figure within the medical professions.

Works cited

Aziz, Ashraf M., McKenzie, James C., Wilson, James S., Cowie, Robert J., Ayeni, Sylvanus A. and Dunn, Barbara K. "The Human Cadaver in the Age of Biomedical Informatics." *The Anatomical Record (New Anatomy)* 269, 2002: 20-32.

Benjamin, Walter. "The Work of Art in the Age of Mechanical Reproduction." *Iluminations*. London: Fontana, [1936] 1992.

Buck-Morss, Susan. "Aesthetics and Anaesthetics: Walter Benjamin's Artwork Essay Reconsidered." *October*, No. 62, Fall (1992): 3-41.

Cheselden, William. *Osteographia: or, the Anatomy of the Bones.* London: W. Bowyer, 1733.

Chevalier, Thomas. *Observations in defence of a bill brought lately into parliament for erecting the Corporation of Surgeons of London into a College and for granting and confirming to such colleges certain rights and privileges: including a sketch of the history of surgery in England*. London: J. Johnston & J. Debreth, 1797.

Chevalier, Thomas. *An Introduction to a Course of Lectures on the Operations of Surgery*. London: W. Smith, 1801.

Cassell, Joan. *The Woman in the Surgeon's Body*. Cambridge, Massachusetts: Harvard University Press, 1998.

Darzi, Ara. "Cybersurgery: Robots in the operating theatre." Talk given at the Hunterian Museum, Royal College of Surgeons of England, UK, 14 December 2006.

Darzi, Ara and Mackay, Sean. "Recent advances in minimal access surgery." *British Medical Journal*, 234 (2002): 31-34.

Doyle, Julie. "Anatomy of the Womb: Imag(in)ing Reproduction in the Discourse of Surgery." *Women: A Cultural Review*, Vol. 17, No. 3, Winter (2006/07): 310-324.

Doyle, Julie. "Historicising Surgery: Sex, Gender, Technology and the Surgical Imaginary." *Social Semiotics*, Vol. 17, No. 3, September 2007:341-359.

Ellis, Harold. *A History of Surgery*. London: Greenwich Medical Media Ltd, 2001.

Enochsson, Lars, Isaksson, Bengt, Tour, René, Kjellin, Ann, hedman, Leif, Wredmark, Torsten and Tsai-Felländer, Li. "Visuospatial Skills and Computer Game Experience Influence the Performance of Virtual Endocscopy." *Journal of Gastrointestinal Surgery*, Vol. 8, No. 7 (2004): 874-880.

Hance, J., Aggarwal, R., Undre, S.. and Darzi, A. "Skills training in telerobotic surgery." *International Journal of Medical Robotics and Computer Assisted Surgery*, 1(2) (2005): 7-12.

Hansen, Miriam. "Benjamin, Cinema and Experience: 'The Blue Flower in the Land of Technology.'" *New German Critique*, 40, Winter (1987): 179-224.

Hunter, William. *The Anatomy of the Human Gravid Uterus exhibited in figures*. Birmingham: John Baskerville, 1774.

Intuitive Surgical. 23 January 2007.
< http://www.intuitivesurgical.com/products/index.aspx>

James, D.R.R., Purkayastha, S. Athansiou, T., Shafiq, O., Paraskevas, P. and Darzi, A. "Anatomy: The future teaching of undergraduates." *Hospital Medicine*, Vol. 65. no. 11, November (2004): 681-685

Jastrow, Holger and Holinderbäumer, Anke. "On the Use and Value of New Media and How Medical students assess Their Effectiveness in Learning anatomy." *The Anatomical Record (Part B: New Anatomy)* 280B (2004): 20-29.

Joyce, Kelly A. "From Numbers to Pictures: The Development of Magnetic Resonance Imaging and the Visual Turn in Medicine." *Science as Culture*, vol. 15, No. 1, March (2006): 1-22.

Justamond, John Obadiah. *Surgical Tracts*. London: T. Cadell, 1789.

Katz, P. *The Scalpels' Edge: The Culture of Surgeons*. Boston: Allyn & Bacon, 1999.

Lanfranco, Anthony R., Castellanos, Andres, Desaio, Jaydev P. and Meyers, William C. "Robotic Surgery: A Current Perspective." *Annals of Surgery*, Vol. 239(1), January (2004): 14-21.

Leslie, Esther. *Walter Benjamin: Overpowering Conformism*. London: Pluto Press, 2000.

Mack, Michael. "Minimally Invasive and Robotic Surgery." *The Journal of the American Medical Association*, Vol. 285(5), February 7 (2002): 568-572.

McGrath, Roberta. *Seeing Her Sex: Medical Archives and the Female Body*. Manchester: Manchester University Press, 2002.

McKeown, P.P., Heylings, D.J.A., Stevenson, M., McKelvey, K.J.H., Nixon, J.R. and McCluskey, D.R. "The impact of curricular change on medical students' knowledge of anatomy." *Medical Education*, 37 (2003): 954-961.

Moorthy, Krishna, Munz, Yaron, Adams, Sally, Pandey, Vikas and Darzi, Ara. "A Human Factors Analysis of Technical and Team Skills Among Surgical trainees During Procedural Simulations in a Simulated Operating Theatre." *Annals of Surgery*, Vol. 242(5), November (2005): 631-639.

Moore, Wendy. *The Knife Man: The Extraordinary Life and Times of John Hunter, Father of Modern Surgery*. London: Bantam Press, 2005.

Moorthy, K., Vincent, C. and Darzi, A. "Simulation based training." *British Medical Journal*, 330 (2005): 493-494.

National Library of Medicine. "The Visible Human Project." 11. Sep. 2003. 8 January 2007: < www.nlm.nih.gov/research/visible/visible_human.inc>

Pringle, Rosemary. *Sex and Medicine: Gender, Power and Authority in the Medical Profession*. Cambridge: Cambridge University Press, 1998.

Purkayastha, Sanjay, Athansiou, Thanos, Casula, Roberto and Darzi, Ara. "Robotic Surgery: A Review." *Hospital Medicine*, Vol. 65, No. 3, March (2004): 153-159.

Richardson, Ruth. *Death, Dissection and the Destitute: the Politics of the Corpse in Pre-Victorian Britain.* London: Routledge, 1987.

Robb-Smith, A.H.T. "Medical Education at Oxford and Cambridge Prior to 1850." *The Evolution of Medical Education in Britain*. Ed. F.N.L. Poynter. London: Pitman Medical Publishing Company,

1966.

Rockall, T.A. and Darzi, A.W. "Tele-manipulator robots in surgery." *British Journal of Surgery*, 90 (2003): 641-643

Stoyanov, Danail, Darzi, Ara and Yang, Guang Zhong. " Practical approach towards accurate dense 3D depth recovery for robotic laparoscopic surgery." *Computer Aided Surgery*, 10 (4), July (2005): 199-208.

Toltech.net. "VH Dissector." 8 January 2007. <www.toltech.net/products/vh_dissector/index.htm>

Treichler, Paula, Cartwright, Lisa and Penley, Constance (eds). *The Visible Woman: Imaging Technologies, Gender and Science*. New York: New York University Press, 1998.

University of Washington, Structural Informatics Group. "The Digital Anatomist Information System." 26 January 1999. 18 March 2007. <sig.biostr.washington.edu/projects/da/>

Weigel, Sigrid. *Body-and Image-Space: Re-reading Walter Benjamin*. London: Routledge, 1996.

Wegenstein, Bernadette. *Getting Under the Skin: The Body and Media Theory*. Cambridge, Massachusetts: MIT Press, 2006.

Young, Katharine. *Presence in The Flesh: The Body in Medicine*. Cambridge, Massachusetts: Harvard University Press, 1997.