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Guest Editorial

Advanced technology and the future of facial prosthetics in head and neck reconstruction

Facial prosthetics has a long history that extends back to ancient man. The course of facial prosthetics has altered over time as improvement in surgical techniques and materials arrived. The need for facial prosthetics presumably also altered over time with social changes and changes in disease management.

The past century has brought several remarkable changes that influenced the delivery of facial prosthetic care. After the Second World War, the availability of acrylic resins had a major impact on facial prosthetics, as did the rapid advances made by reconstructive surgery. This was followed by the introduction of silicone elastomers in the 1960s. By the late 1970s, silicone elastomers were in widespread use in facial prosthesis construction. The introduction of osseointegrated implants into facial prosthetic care emerged in the 1980s and was in widespread international use by the early 1990s.

As remarkable as these developments were, perhaps even more notable is that the fundamental techniques used to design and construct facial prostheses remain unchanged. For over half a century we have become adept at optimizing every possible potential of available materials to enhance treatment outcomes with facial prosthetics. As laudable as these endeavours are, little progress has been made in advancing fundamental techniques employed in facial prosthesis design and construction.

To realise the future potential of facial prosthetics as a modality of head and neck reconstructive care, it is important to understand what needs to be achieved. In this regard there are perhaps two prime issues. The first issue is that there is little or no evidence-based work to support the value of facial prosthetics. Available information is of low strength of hierarchy of evidence. The second issue is that construction of facial prostheses makes use of what may be considered low-level, low-value technology. Facial prosthesis construction techniques have essentially remained unchanged for many decades and fall into the domain of an art form. The issue of facial prosthetics remaining as a relatively unchanged art form that is based on low hierarchy of strength of evidence presents a challenge for future development of this modality of care as a viable treatment option.

The challenges to facial prosthetics come from a variety of directions. An example is the rate of development of microvascular reconstructive and other autogenous surgical techniques over the past two decades. These procedures may be seen by surgeons as desirable, in part because they free the surgeon of the complexities of multi- or interdisciplinary care, obviate the need for further infrastructure required to deliver facial prosthetic care and may free the patient from need for extended care. Furthermore, the low numbers of individuals being trained in facial prosthetics constitutes a further limitation on delivery of facial prosthetic care. Reticence of funding agencies to support facial prosthetic care creates even further limitation on the field. For facial prosthetics to not only survive these challenges and to be able to find its rightful place as a treatment option in head and neck reconstruction, is going to require change and innovation.

Change with regard to evidence-based medicine and dentistry will have to be addressed and will come through revision of approaches to research. For this to occur, those educating anaplastologists, maxillofacial technologists, prosthodontists and surgeons will need to ensure that appropriate research training is provided. Those conducting research must ensure that attention is paid to evidence-based research and its application to evidence-based clinical practice.

Immediate opportunity exists to rapidly change the perceived value of facial prosthetics by employing advanced technology in facial prosthesis design and construction. The development and convergence of technology solutions with use or potential application to diagnosis, treatment planning, treatment and functional outcomes assessment in head and neck reconstruction is occurring at an unprecedented pace. Many of these technological solutions are just beginning to be employed clinically, are under development or may not yet be known to clinicians. Some of these technologies have immediate implications for delivering increased value in facial prosthetic care. Within this band of technologies, there are a variety of data acquisition and advanced manufacturing technologies that also have potential for application to facial prosthetic

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care delivery. Yet, many in the field of facial prosthetics have done little to embrace or explore these technologies.

For both dental and medical personnel involved in facial prosthetic aspects of head and neck care, there exists a significant and important opportunity to deliver an enhanced service through technology implementation. Consider three technologies alone: three-dimensional data acquisition, three-dimensional modelling and computerized colour formulation. Industry employs these technologies routinely, as do aspects of health care and yet such obvious applications for facial prosthetics go hardly recognized within the field.

For facial prosthetics to achieve its full potential in the field of head and neck reconstruction, a fundamental change in perception is required by those delivering facial prosthetic care. If facial prosthetics is to be successful in the future, it will need to create value in the eyes of those end-users of the service. From a strategic service planning and health economic viewpoint, it can be argued today, that while patients are the beneficiaries of care, the end-users are not always the patient but rather the fund holders. Fund holders will invest in activities where they see creation of value with deployment of care systems that make treatment more widely available, reduce costs of care and enhancement of outcomes. The status quo with facial prosthetic care delivery may have difficulty meeting these requirements. An answer thought to be important to creating value in facial prosthetics lies in technology solutions.

To engage technology solutions, the involved professional bodies will need to move beyond some previously emotive issues. It may be argued that historically, creating a facial prosthesis has been viewed as an artistic activity. Today, however, it may be contended that producing a facial prosthesis is a biotechnological process involving replication of a body part. Those adhering rigidly to the former position may find the introduction of advanced manufacturing and other technology solutions threatening. Perhaps, a close analogy here is how graphic designers may have responded to the introduction of computers to their field. Today, no one in graphic design could consider their profession without computing technology. Indeed, it could be speculated that denial of the technology would likely have spelt demise of graphic design as a profession. By embracing technology solutions, graphic design today is an extremely robust and progressive segment of the economy. It may be considered that this transformation occurred primarily because the graphic design profession realized how technology presented a creative tool that could create value. While it may be debated that the symmetry of this argument is not perfect, the lessons for facial prosthetics are patently clear.

For those contributing to the artistic aspects of facial prosthetic care, introduction of technology solutions holds benefits that will enhance the quality of their working life and status of their contribution to patient care. The art aspects of facial prosthetic care can consume considerable amounts of time and effort. With this comes fatigue. Fatigue also comes from having to repeat-treat patients at intervals. Technology removes the drudge factor so that the treatment effort can be directed at the high value aspects of care. As an example, within the author's teams, first-hand experience of this has been encountered with rapid prototyping and colour formulation technology. With the technology change there is additional benefit to those delivering art-based aspects of care since they are transformed to high-technology workers. This has obvious benefit to the status of these individuals within the care team and health care system.

With these thoughts in mind, a meeting was held to consider the role of Advanced and Digital Technologies in Facial Reconstruction from the 20–23rd March 2002 at the Misericordia Hospital, Edmonton, Canada. The workshop was con-jointly hosted by COMPRU/University of Alberta, Edmonton, Canada and the Maxillofacial Unit, Morriston Hospital, Swansea, Wales. The purpose of the workshop was to bring together a representative group with an interest in technology applications in facial reconstruction as well as potential industry partners. The workshop considered:

- data acquisition
- conventional and rapid prototyping
- treatment planning applications for resections and craniofacial surgery
- oral and extraoral implant planning
- computerized colour matching and formulation
- non-destructive digital implant assessment tools
- navigation systems and robotic tools
- functional outcomes assessment tools

The meeting was attended by individuals from 13 countries. The intent of the meeting was to allow clinicians, researchers and industry partners to explore the future potential of advanced and digital technologies to the field of facial reconstruction. The meeting revealed that there are a number of international centres with a strong and visionary commitment to establishment of technology solutions to facial prosthetics and facial reconstruction. Importantly, the meeting identified that industry partners possess fascinating technologies that have application to facial reconstruction. Industry partners at the meeting frequently expressed concern that they possess technologies that may have application but need clinician involvement to explore the technologies.

A remarkable outcome of the meeting was a unanimous vote to continue on to a major international meeting that would address the subject of advanced technologies on the broader front of head and neck reconstruction. It appeared from discussion on the content of the meeting that just as technology was converging, so was the need for facial prosthetics to be integrated into the broader field of head and neck reconstruction. Planning for this international conference has been initiated.

The use of technology solutions in facial prosthetics holds the promise of bringing value to this field of care. The professional disciplines involved in delivering this care will likely become increasingly involved in the virtual technology world. This holds real potential to create value with cost reduction, improvement in productivity and enhancement of technical quality of care. In striving to create this value there is no room for naivety. The challenges are real and considerable but the benefits too great to ignore. A strategic bridge has to be built between the status quo and the future for facial prosthetics. There will be a need for transformation of educational programmes. Work will need to be done with the end users of the services. New business models with concentration on centers of excellence will likely be important. Concerted efforts to identify and attract industry partners to the field will be needed and will constitute yet another challenge. None of this can be achieved without close and unusual co-operation between the range of

professional bodies such as surgeons, prosthodontists, maxillofacial prosthetic technologists, anaplastologists and radiologists. This level of co-operation will also need to involve industry partners who possess technologies that hold potential.

The challenge is ambitious but experience to date confirms that this is achievable. The result would create an area of professional activity with great meaning for the future. Of course, in the words of Edwards Deming the quality expert who counselled business, you do not have to do this, survival is not compulsory.

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