Prosthetic Surgery in Urology

Asif Muneer
Ian Pearce
David Ralph
Editors

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Editors
Asif Muneer
University College London Hospitals
London
UK

David Ralph
Institute of Urology
University College London Hospital
London
UK

Ian Pearce
Department of Urology
Central Manchester University Hospitals
NHS Foundation Trust
Manchester
UK

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Foreword

It is a great pleasure to introduce this book on prosthetic surgery in urology. Asif, Ian and David are amongst the foremost leaders in the field of prosthetics in the UK, and between them they have commissioned an impressive group of authors, encompassing the whole field of the correction of functional disorders affecting the genitourinary tract.

The reader of this book will have access to the distilled wisdom of a number of the key opinion leaders in the field. I have no doubt that this book will provide an essential addition to any library, to provide the reader with a crisp, updated, user-friendly and relevant guide to the use of prosthetics in urology.

This is a challenging field of surgery which relies upon careful evaluation of patients, adequate counselling and meticulous surgical technique. Please recall the dictum: "A good surgeon knows what to do. A better surgeon knows when to do it. The best surgeon knows when not to do it." There is no other field within urology where this is more applicable.

Prof Christopher Chapple, BSc, MD, FRCS (Urol), FEBU
Consultant Urological Surgeon, Royal Hallamshire Hospital
Honorary Professor of Urology, University of Sheffield
Visiting Professor of Urology, Sheffield Hallam University
Secretary General, European Association of Urology

Preface

The use of man-made materials to replace or substitute the function of damaged or absent urogenital organs has been described for well over 5000 years. The Romans described using metal catheters to drain the bladder. Also wooden sticks placed within the male urethra or under the penile skin were the earliest documented examples of penile prostheses.

Whilst there are numerous examples of relatively crude forays into the realm of urogenital prosthetic surgery, it was not until the early twentieth century that advancements in biomaterials allowed the development of either functionally proficient or in the case of testicular prostheses, cosmetically acceptable prosthetics suitable for widespread patient application.

These biomaterial advances enabled both numerous and rapid developments in penile prostheses and artificial urinary sphincters and ultimately to functional restoration for men suffering with erectile dysfunction or urinary incontinence thus ensuring that the deleterious effects of surgical treatment for pelvic cancers or benign prostatic enlargement were able to be suitably and reliably addressed.

Prosthetic surgery for female urinary incontinence, a condition afflicting approximately 30 % of the female population, has been a major breakthrough, positively changing the quality of life for women across the globe who would have previously been reliant on containment products or long-term catheters.

Despite the undoubted success, all prosthetic devices are continually subject to ongoing modifications and developments aiming to enhance their acceptability, durability, ease of implantation and functionality whilst reducing their associated complications such as erosion and potential infection risk.

Future developments in urogenital prosthetic surgery and urology in general continue to excite and with ongoing research into new biomaterials, stem cells and tissue engineering, the boundaries both functionally and cosmetically continue to be pushed further and further.

This book covers the common prosthetic surgical procedures in urology and provides clinicians with an overview of the available prostheses as well as a step-by-step guide to the surgical procedures provided by experts in each field.

This is a valuable resource for established urologists and urology trainees with an interest in prosthetic surgery, as well as nursing staff and allied healthcare professionals involved in the perioperative management of these patients.

The editors are grateful to all of the contributors who have helped to create this unique and informative guide to prosthetic surgery in urology.

London, UK — Asif Muneer
Manchester, UK — Ian Pearce
London, UK — David Ralph

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A. Muneer
I. Pearce
D. Ralph

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An Introduction to Prosthetic Devices

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Asif Muneer and Ian Pearce

Abstract

The word "prosthesis" originates via New Latin from the Greek word "prostithenai" meaning to 'add to' or 'in addition'. Although commonly used for external limb replacements, the term also encompasses surgical prostheses used in a wide range of surgical subspecialties.

Keywords

Prosthetic surgery • Biofilms • Stem cells • Tissue engineering

Prosthetic surgery is not new, the earliest recorded examples being that of a wooden toe in the New Kingdom of Egypt (1600–1100 BC) and an iron leg made for the warrior queen Vishpala, documented in the ancient Sanskrit poem collection of Rigveda, one of the four Vedas, or sacred texts of Hinduism, (circa 1500–1200 BC). These prosthetics however, had no function and were merely anatomical in nature, it was not until approximately 800 BC that a functioning prosthesis was discovered near Thebes in Egypt.

Urological surgery has always been at the forefront of innovative developments in surgery; from the development of endoscopy, the early adoption of laparoscopy and minimally invasive surgery to the utilisation of robot assisted surgery for pelvic cancers and more recently upper tract malignancy.

The male external organs of the urinary tract namely the penis and scrotal contents are areas of the body that have become synonymous over the years with masculinity, virility, power and fertility with the emphasis varying amongst different cultures and geographical regions. Hence any functional loss related to these organs either through traumatic injury or as a result of malignancy is often linked to a loss of quality of life and self-esteem together with a negative psychological impact. It is both relevant and interesting to note that some of the first medical prostheses were developed to replace either missing testicles or to restore function, either voiding or sexual to the penis. In modern urological practice, the major technological advances have been witnessed within the areas of penile prostheses and the artificial urinary sphincter through the use of improved biomaterials and design that have also

A. Muneer, MD, FRCS(Urol) (✉)
Department of Urology and Andrology,
University College London Hospitals, London, UK
e-mail: mramuneer@gmail.com

I. Pearce, B.Med.Sci, BMBS, FRCS(Urol)
Department of Urology, Central Manchester
University Hospitals NHS Foundation Trust,
Oxford Road, Manchester M13 9WL, UK
e-mail: Ian.Pearce@cmft.nhs.uk

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Table 1.1 Properties of the ideal material for prostheses

1. Durable
2. Inert
3. Negligible particle migration
4. Low infective risk
5. Functionally resilient
6. Easy to handle
7. Cost effective

led to the evolution and improvement in ureteric stents, nephrostomy tubes and urinary catheters resulting in an increasingly wide and varied range available for practical use.

An ideal prosthesis requires components and materials which can either restore or reproduce the physiological function of an organ (Table 1.1). The rapid developments in material science have provided a vast array of potential materials which are inert and therefore suitable for use within the human body and have subsequently led to an increasing number of prostheses with more indications being available in urological practice.

However, as discussed later in this book, complications still exist as with any surgical intervention and the implantation of foreign material within the urinary tract will always be at a potential risk of prosthesis infection, device malfunction and erosion as well as particle migration. Careful as well as appropriate patient selection and preparation, is of paramount importance in order to reduce the patient morbidity and patient dissatisfaction.

Surgical specialities such as Trauma and Orthopaedic surgery where prosthetic surgery forms the major component of a surgeons workload necessitate a specific theatre set up and preparation and demand that all involved personnel are well versed in protocols aimed at reducing the risk of infection, and ensuring that the handling of the prosthesis itself is performed cleanly and efficiently with a minimal risk of contamination. In contrast prosthetic surgery in urology forms a small proportion of the surgical volume and overall workload focusing almost exclusively on either mainstream core procedures such as ureteric stenting and testicular prosthesis insertion and the more complex prosthetic surgery such as inflatable penile prosthesis insertion, artificial urinary sphincter insertion and neuromodulation. These more complex procedures tend to polarize to subspecialist centres such that high volume surgeons have the necessary equipment and theatre staff well versed in these procedures.

With penile prosthesis surgery the infection risk relates to the surgeons' case volume with lower rates of infection being witnessed in high volume centres. But how do we define a high volume centre? There is currently no evidence to suggest how many procedures should be performed in order to be deemed a high volume centre, indeed, defined values for the incidence of prosthesis infection or other morbidities does not exist and thus minimum numbers associated with such figures are impossible to extrapolate and delineate.

If we take the UK practice as an example, there are approximately 500 penile prostheses inserted per annum, which are performed in over 20 centres across the country with huge variation in numbers between centres. Some will perform 1 or 2 per year whilst the largest centre performs approximately 200 per year. The remaining centres therefore average approximately 15 prostheses per year if evenly distributed although amongst some of these there will be centres performing in excess of 30. Thus, it would seam reasonable to recommend an arbitrary minimum figure based on this average of 12–24 per year equating to at least one –two penile prosthesis implantations per month. This would enable surgeons, scrub teams and ward staff to maintain the necessary skills for prostheses surgery, in addition to facilitating a compromise between high volume centralization and geographical representation thus ensuring that patients nationally can be offered prosthetic surgery closer to home.

Although this may be a model suitable for primary prosthesis surgery, revision surgery is less common, more demanding and complex and carries with it an associated higher risk of infection. For instance the quoted infection risk for a primary inflatable penile prosthesis is 4 % with a reduction in the rate to 2 % in large volume centres. With revision surgery the infection rate doubles.

However, if a center is only performing 10 penile prostheses per annum and has a single case of prosthesis infection, the infection rate increases substantially to 10 % for that year. Revision sur-