

From ancient to contemporary times: a concise history of incisional hernia repair

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Abstract

Purpose This historical review explores the origins of incisional hernia surgery.

Methods Resources from each significant historical time period were reviewed, namely ancient times, the Greco-Roman period, the Middle Ages and the dawn of the surgeon anatomist, and the modern era.

Results Although incisional hernias only started to be widely reported in the literature in the early twentieth century, an awareness of the risk of incisional hernia formation dates back to ancient times.

Conclusions Sometimes, it is important to look back at the history and evolution of a topic to continue making positive advances in that field.

Keywords History · Hernia · Ventral

Introduction

In the *Traité du Narcoisse* (1893), the French author André Gide provides a memorable statement that Robert Bendavid applies to hernia surgery ‘Everything has already been said, but because non one listens, we have to keep going back and start all over again’ [1].

Since the dawn of surgical history, hernias (or ‘ruptures’, as they were often described) have been of interest [2–4]. Unsurprisingly, common symptomatic hernias, namely groin and umbilical hernias, have provided the focus of this interest [3, 5, 6]. It was not until the second half of the nineteenth century at the start of the era of modern abdominal surgery that post operative eventration, what we now call incisional hernia, increased in number and were documented [5–10]. At the same time, surgical techniques aimed at their correction developed and multiplied. Despite this, an awareness of the importance of the integrity of the abdominal wall in preventing herniation originated in the early years of written history, and thereafter each historical time period has played a role in developing our understanding of incisional hernias.

Ancient times

Descriptive anatomy of the anterior abdominal wall dates back over 6,000 years, to the beginning of civilisation, the Valley of the Nile and the ancient Egyptian papyri. These texts, often by unknown authors, were written in a time when medicine was magico-religious, and the first steps in inductive reasoning were being taken. The papyrus that most closely resembles a modern surgical textbook, the Edwin Smith Papyrus, mysteriously does not mention the abdomen or hernias [11].

It is the Ebers Papyrus (1500 BC), found in the tomb of Thebes in 1862 by Professor George Ebers, that provides the first descriptions of the anterior abdominal wall (Fig. 1) [2]. The final section deals with abdominal swellings and tumours and, although there is no mention of incisional hernias, the first description of an epigastric hernia is provided [12].

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Fig. 1 The Ebers Papyrus

Instruction for a swelling of the coverings of the brow of his abdomen: If you examine a swelling of the coverings of the brow of his abdomen above the umbilicus. Then you should place your finger on it and you should palpate his abdomen...that which comes into being comes forth when he coughs.

The text follows with the pronouncement and the treatment [12],

Then you shall say concerning it ‘this is a swelling of the covering of the abdomen, an illness that I shall treat’.... Falling to the ground [it] returns likewise.... You should heat it to imprison it in his belly.

Although this passage is unclear, it is possible that the authors noticed that this type of hernia tends to reduce when the patient lies down. Furthermore, it has been suggested by medical historians that the gentle heat described in the passage was intended to relax the abdomen to facilitate reduction of the hernia [13].

In the Far East, a completely separate system of medicine developed, quite different from its Arabian and Greco-Roman counterpart. Chinese medicine employed the use of herbal remedies to restore harmony. Surgery was very uncommon and Chinese medicine played little part in the history of hernia surgery.

The Greco-Roman period (460BC–AD500)

Interestingly, the Corpus Hippocraticum, a collection of around 70 early medical works from ancient Greece strongly associated with the physician Hippocrates and his teachings, mentions hernias only in passing, and it has been suggested that the texts may be incomplete [14, 15].



Fig. 2 Galen of Pergamon

Several centuries later, it was a Roman named Aulus Cornelius Celsus (first century AD) who first described the importance of surgical closure of the abdominal wall [16]. The procedure was termed ‘gastrorrhaphy’ originating from the Greek ‘gastir’ meaning abdomen and ‘rhaphy’ meaning suture. In fact, what Celsus was describing was a layered closure of the abdominal wall to prevent an incisional hernia. A century later, Aelius Galenus (Fig. 2), better known as Galen of Pergamon, a Roman of Greek origin and arguably the most prominent physician of the Greco-Roman period, provided a detailed description of mass closure of the abdominal wall [13] (Fig. 3).

In stitching the needle should be thrust from without inwards through skin and rectus muscle, and then from within outwards through the muscle and skin, repeating this until the wound is closed. Some operators include the peritoneum in the stitches, but this is not usual. The dressing should be soft wool dipped in oil moderately warm and cover the space between the flanks and armpit

It seems that Galen was aware of the risk of incisional hernia following abdominal surgery and he describes in detail paramedian incisions, in order to prevent a hernia from developing—an incision that was used commonly until the late twentieth century [13].

A wound in this situation is less dangerous than in the mid-line, since the thin aponeuroses are lacking. In the mid-line stitching is accomplished with difficulty and the intestines are more likely to protrude and be hard to replace

reviews on hernia surgery of the time entitled, ‘*A Treatise on Hernia With a New Process for Its Radical Cure*’. The treatise did not include incisional hernias in the classification but included traumatic hernias “where the hernia is known to be produced by a wound or a burn” in the section entitled ‘causes for hernias’. Dowell, included in his treatise “the authors invagination and ligature technique” for hernia repair, which he assured the reader was suitable for ‘all external hernias, scrotal, umbilical, funicular, inguinal, crural, femoral, intestinal, ventral, epigastric...’. He concluded that

Giving about all is known on the subject, there will never be a better method invented than the author’s

It was not until 1896 that a French Surgeon, Edouard Quenu in his paper entitled ‘*Traitement opératoire de l’éventration*’ differentiated post-operative eventration and real eventration, which he claimed was due to pregnancy [30]. This was the first documented classification to distinguish incisional hernias from other types of hernia [10].

The dawn of modern surgery (1900–WWII)

Before the introduction of anaesthesia in 1846 by William Morton and antisepsis by Joseph Lister in 1865, restraining methods were the treatments of choice for the rare cases of incisional hernia [6, 29]. As survivable abdominal surgery became more common, so too did the incidence of incisional hernias. In the *Annals of Surgery* in 1901, Brindley Eads wrote,

The occurrence of ventral hernia as a sequence of abdominal section is so common that it should command our thoughtful consideration [7]

These sentiments were reinforced in several other publications at the time [8, 9]. Since then over 2,000 peer reviewed articles on the topic of incisional hernia have been published. Many of these introduced a new technique or suggested a modification of an established technique for the repair of incisional hernia. Whilst several have played an important role in shaping incisional hernia surgery, this historical review mentions only the most significant of these. Surgical repair developed along three lines:

1. Simple laparoplasty: suturing
2. Organic auto or heteroplasty: grafting
3. Alloplasty: the use of prosthetics

Simple laparoplasty: suturing

Simple suturing and more complex darns were the most commonly utilised repairs in this period. In 1886, Maydl

[31] performed an incisional hernia repair by dissecting out the various musculo-fascial layers and repairing them separately. Quenu [30] also advocated layered closure of postoperative eventration using simple sutures. Others, such as Jonnesco, proposed the use of ‘U’ shaped stitches through the rectus sheath, and Frappier described the mass closure of the hernia defect with ‘figure of eight’ sutures [32, 33]. In 1899, Mayo [34] described his famous transverse overlapping technique for umbilical hernia and this was adopted by many surgeons for the repair of incisional hernia. Others such as, Witzel, Goepel and Bartlett [35–37], described the repair of incisional hernia from continuous fascial sutures from the external oblique.

In 1954, a British Surgeon, Maingot [38] described his extraperitoneal ‘Keel’ technique for the repair of large incisional hernia. The technique involved widely excising the stretched overlying skin and scar tissue and dissecting the fascial flaps well back to expose healthy margins. The peritoneal hernia sac was then inverted ‘like a boat’s keel’ and the fascial edges approximated with interrupted sutures of floss silk. The approximated edge was then inverted with a continuous suture. Maingot described good results from 81 patients in which he had performed this operation. Despite these good results, in all but the smallest of hernias suture repair resulted in unsatisfactorily high recurrence rates [39]. This spurred surgeons on to explore alternative techniques to reinforce the abdominal wall.

Organic auto or heteroplasty: grafting

In 1910, Kirschner [40] (of the whom the *k-wire*, used in orthopaedic surgery, is named) used heterologous, homologous and autologous fascia, of which the latter was reported to have good results. In 1912, Judd described an overlapping flap of peritoneum, muscle, fascia and scar tissue, and in 1913 Loewe described cutis grafts [41, 42]. Relieving incisions were first described by Gibson [43] in 1920. Nuttall [44] described rectus muscle transplantation in 1926. This involved releasing the muscles at their origins, crossing them and suturing them to the opposite pubic bone. In the following years, free flaps were constructed from freeze-dried human fascia lata, dura mater and skin [10, 45–47]. Reconstruction with autologous material on the whole produced unsatisfactory results. Transplant harvesting was time-consuming and was frequently followed by functional deficits at the donor sites. Moreover, the reconstructions often left bulges through denervated muscles and reherniation rates were high [3]. However, these attempts at grafting represented an important step in incisional hernia surgery and arguably were the precursors of the biological collagen xenografts that are used today.

Alloplasty: the use of prosthetics

The first hernia prosthetics were made of metal. As early as 1900, Goepel and Witzel used silver wire braided meshes [35, 36, 48]. These early meshes were far from ideal. They were stiff, fragile, and toxic sulphur silver formed on their surface. They were modified to contain braided stainless steel and were used as a bridging material between the two edges of the rectus muscles, sometimes as a double layer [49–51]. In 1948, Douglas and Throckmorton, and several years later Koontz, used tantalum gauze [52–54]. These meshes still fragmented and had extremely high rates of infection. Prefabricated perlon and nylon meshes were used by Cumberland; however, the nylon fell apart and the perlon caused an intense inflammatory response [55–57]. The plastics industry came of age during the Second World War. Steel and tantalum became precious metals allocated for military use. Desperate fabricators, who had never thought of plastic as a manufacturing material, began to reconsider. These ‘new plastics’ caught the attention of hernia surgeons, and several new meshes with much more promising characteristics became available. These were polypropylene, polyester, and expanded polytetrafluoroethylene (ePTFE) [57–59].

The modern era (WWII on)

Since the dawn of the plastics era, meshes have been manipulated to include changes in pore sizes, textures and additives. Additives include impregnated antimicrobials and elements of absorbable mesh or non-adhesion forming substances in hybrid meshes. More recently, biological materials have been introduced and provide a cross-over between meshes and grafting. The search for the ‘ideal’ mesh still continues today.

Whilst major developments in prosthesis aimed at repairing incisional hernias were being made, advances in surgical technique to prevent incisional hernia formation were also occurring. Perhaps the most significant of these was the work of Jenkins [60]. He used a mechanical and geometric approach to calculate the ideal suture-length-to-wound ratio to prevent incisional hernia formation. Experimentally, Jenkins showed that the length of a mid-line laparotomy incision could increase up to 30% in the postoperative period. If the bites taken in suturing (and hence the length of the suture material used) were not large enough, the suture may cut through the fascia, resulting in wound dehiscence. His well-adopted rule states that the suture-length-to-wound-length ratio should be 4:1, and sutures should be placed 2 cm from the fascial edge and 2 cm from one another.

Some of the most important developments in incisional hernia repair during this time period have been in the technique for placing the mesh. Three methods for implantation of prosthetic mesh have dominated open incisional hernia repair. The first involves placing the mesh inside the peritoneal cavity in contact with the viscera (intraperitoneal inlay or intraperitoneal onlay). Polypropylene mesh anchors to all adjacent tissues and therefore has the propensity to induce extensive adhesions to viscera if placed in a position where it becomes adjacent to bowel. Erosion of the mesh then may occur into the intestines, which is a well-recognised drawback of this technique [61]. However, newer coated meshes, which reduce adhesion formation on the exposed visceral surface of the mesh, have reduced this risk [62]. The second is the premuscular onlay technique, in which the mesh is placed over the abdominal wall closure in the subcutaneous prefascial space. This technique was refined and popularised by Chevrel [63]. The third is the retromuscular sublay technique, in which the mesh is placed over the closed posterior rectus sheath and peritoneum. This technique was popularised by Rives and Stoppa [64, 65]. In fact, Stoppa described retrofascial placement and Rives described retromuscular placement. The combined Rives-Stoppa technique has subsequently been adopted as the gold standard for open incisional hernia repair. However, there is currently insufficient data in the literature to promote the Rives-Stoppa technique ahead of the Chevrel onlay repair [39].

Large incisional hernias with loss of abdominal domain from lateral retraction of the abdominal muscle present a difficult problem because of lack of healthy tissue for mesh placement or primary closure. In 1990, Oscar Ramirez [66] developed his ‘component separation of the abdominal wall’ technique to address this group of complex incisional hernias. The advantage of the component separation technique is that the abdominal wall can be recreated in a one-stage procedure without the need of an additional musculofascial transfer (distant flaps) or the use of a bridging material.

In 1991, LeBlanc [67] reported the first laparoscopic incisional hernia repair. Although not considered to be a pathology that could benefit from this approach, laparoscopic repair of incisional hernias has attained wide acceptance in recent years because of the significant improvements in prosthetic materials and surgical technique.

While surgical incisions are still being utilised, the treatment of incisional hernia will remain important in the surgical domain. Despite the considerable innovation witnessed in the history of incisional hernia surgery, surgical repair is still associated with reasonably high recurrence rates and often limited success. New horizons in incisional

hernia surgery will continue to provide patients and surgeons with a diversity of available options to prevent and manage these difficult hernias.

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