

Severe Blunt Perineal Trauma with Restored Pelvic Function after Complete Anatomical Reconstruction

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Background	Severe perineal trauma resulting from motor vehicle collisions (MVCs) is an infrequent yet formidable clinical entity. The management of such injuries is inherently challenging due to the complex regional anatomy, the high-energy mechanisms typically involved, and the current lack of standardized treatment protocols. While extensive literature exists on perineal trauma in obstetrical (often lower-energy, blunt trauma) and military (frequently higher-energy, penetrating trauma) contexts, the distinct intermediate energy levels and unique injury patterns associated with MVCs limit the direct extrapolation of findings from these other settings.
Summary	This case report details the multidisciplinary management of a 17-year-old female who sustained severe perineal and pelvic injuries following a high-speed MVC. Her injuries included extensive disruption of the anorectal complex and substantial soft tissue avulsion. Optimal reconstruction necessitated a coordinated, multispecialty surgical approach involving trauma surgery, orthopedic surgery, vascular surgery, colorectal surgery, urogynecology, and plastic surgery. Definitive reconstructive procedures included overlapping anal sphincteroplasties, anoplasty, levatoroplasty, and comprehensive perineal reconstruction to restore anorectal cylinder integrity and augment tissue volume between the vagina and anus. An inferior gluteal artery perforator (IGAP) flap was utilized for soft tissue coverage, and biologic extracellular bladder matrix was employed to promote tissue regeneration and healing. The patient's recovery period was characterized by marked functional improvement and restoration of anorectal function, offering potential insights into pathways for achieving positive outcomes in these devastating injuries.
Conclusion	Severe perineal trauma presents unique and complex challenges for both the patient and the surgical team, primarily due to the intricate anatomy and critical organ functions concentrated in this region. While adhering to established tenets of perineal trauma management, such as proximal fecal diversion and early, meticulous surgical repair, this case demonstrates that advanced reconstructive techniques and innovative wound closure strategies may be indispensable for achieving excellent functional and aesthetic outcomes. A coordinated, multidisciplinary approach is paramount in navigating these complex injuries.
Key Words	blunt perineal trauma; overlapping sphincteroplasty; levatoroplasty; inferior gluteal artery perforator flap; fecal diversion; ileostomy; biologic matrices

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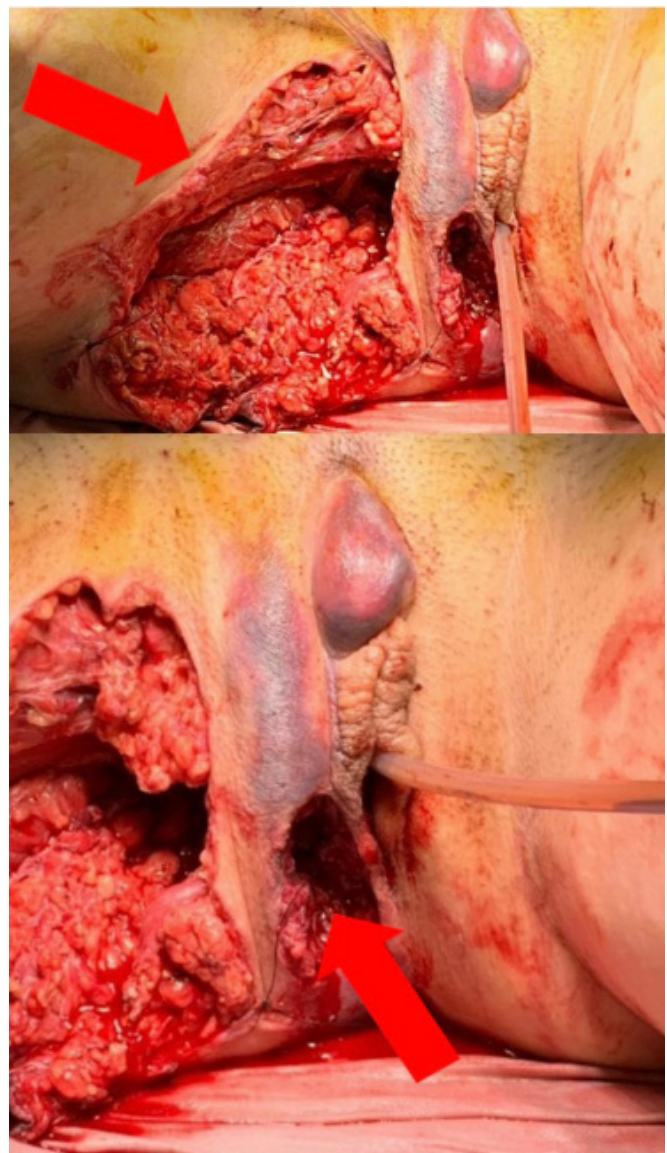
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Case Description

A 17-year-old female with no significant past medical history presented as a Level I trauma activation following a high-speed MVC. She was a restrained passenger whose leg was reportedly resting on the dashboard at the time of impact, when the vehicle struck a pole and was sheared in half. The patient was partially ejected through the windshield and required prolonged extrication at the scene. Upon arrival, she was hypotensive. An initial Focused Assessment with Sonography for Trauma (FAST) examination was indeterminate. Plain radiographs revealed a type III open bilateral anterior pelvic ring fracture with greater than 5 cm of pubic diastasis, a complete left sacral ala fracture, a segmental fracture of the right femur, a right bicondylar tibial plateau fracture, and a left clavicular shaft fracture. Two extensive open pelvic wounds were identified: a medial laceration originating at the inferior aspect of the right labia majora and extending through the perineum, distal rectum, and anus; and a right posterior defect measuring approximately 30 cm, extending from the pubic ramus into the gluteal musculature and posterior thigh compartment, associated with the segmental right open femur fracture (Figure 1). Active bleeding was observed from the wounds, which were packed with gauze. A massive transfusion protocol was initiated, a pelvic binder was applied, and the patient was taken emergently to the operating room.

In the operating room, a Foley catheter was placed, returning gross hematuria. Hemostasis of the right ischial fossa was achieved through suture ligation of multiple bleeding vessels and transected muscles. An exploratory laparotomy revealed approximately 1000 mL of hemoperitoneum. An actively bleeding mid-jejunal mesenteric tear was identified and suture-ligated without complication. Inspection of the cecum revealed 5 cm and 3 cm serosal tears, which were repaired with interrupted 2-0 silk sutures in a Lembert fashion. A retrograde cystogram performed with isosulfan blue demonstrated extravasation of dye from the perineal wound, with no evidence of intracorporeal leakage. The extraperitoneal bladder was exposed, and a bladder perforation was identified on the right lateral wall. The bladder was repaired in layers with absorbable sutures. A subsequent leak test was negative. An external Jackson-Pratt drain was placed adjacent to the bladder repair and secured to the skin. A temporary abdominal closure was performed using a vacuum-assisted device.

Figure 1. Extent of Initial Perineal and Pelvic Trauma. Published with Permission



Pelvic examination under anesthesia, including a vaginal speculum exam, revealed no vaginal lacerations or active bleeding. Flexible sigmoidoscopy performed to 25 cm demonstrated a normal sigmoid colon but confirmed disruption of the anterior distal-most rectum and the entire anal canal.

On post-trauma day (PTD) 2, a second-look laparotomy was performed, revealing no new intra-abdominal issues. A diverting loop ileostomy was created, and the abdomen was definitively closed.

Definitive pelvic and perineal reconstruction was initiated on PTD 3. Detailed examination under anesthesia revealed a complex, deep perineal laceration extending from the inferior aspect of the right inguinal crease to the right posterolateral position relative to the anal verge. This involved a 1.5 cm disruption of the right-anterior rectum, complete disruption of the anterior-right external and internal anal sphincters, and nearly complete disruption of the right levator ani muscle complex within the confluence of the right ischioanal, ischiorectal, and pelvirectal spaces.

Anorectal reconstruction commenced with closure of the rectal defect using a running absorbable suture, extending down to the level of the sphincters (Figure 2). Next, an overlapping sphincteroplasty of the internal anal sphincter muscle was performed using interrupted vertical mattress sutures of 0 Polysorb. The external anal sphincter muscle was then independently repaired in a similar overlapping fashion (Figure 3). The adjacent avulsed portion of the levator complex medial to this injury was repaired and imbricated using interrupted 0 Polysorb vertical mattress sutures. The edges of the superficial transverse perineal muscle were identified, debrided, and confirmed to be viable. An overlapping repair of the transverse perineal muscle was then performed using vertical mattress sutures of 0 Polysorb (Figure 4). Following these muscular repairs, an anoplasty was performed by approximating the torn distal rectal mucosa and anal canal epithelium with a running, locked 2-0 Polysorb suture. Rigid proctoscopy confirmed the integrity of the rectal mucosal repair and demonstrated no evidence of anal stenosis. A leak test was negative.

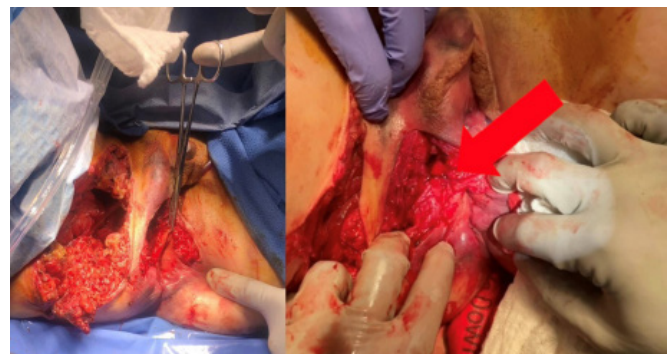
Attention was then turned to the complex right perineal wound, which measured approximately 12 cm in the anterior-posterior dimension and had additional superior tracking in the subcutaneous space lateral to the right labia. The wound margins were sharply debrided. An avulsed branch of the pudendal nerve was identified within the wound bed; a pudendal neurectomy was performed by suture ligating the proximal portion of the avulsed nerve with a 2-0 silk suture and sharply amputating its terminus. An extracellular bladder matrix (EBM) xenograft was placed to reinforce the perineal wound repair and promote tissue regeneration. The perineal wound was closed in layers, with 0 Polysorb sutures used to approximate the avulsed transverse perineal and medial levator fascia. Due to the irregular surface of the deep cavity, an additional 500 mg of morcellated EBM was placed within the wound to ensure comprehensive coverage. A 10 French round Jackson-Pratt drain was introduced via a separate incision superolateral to the right labia and tunneled into

Figure 2. Initial Step in Anorectal Reconstruction. Published with Permission



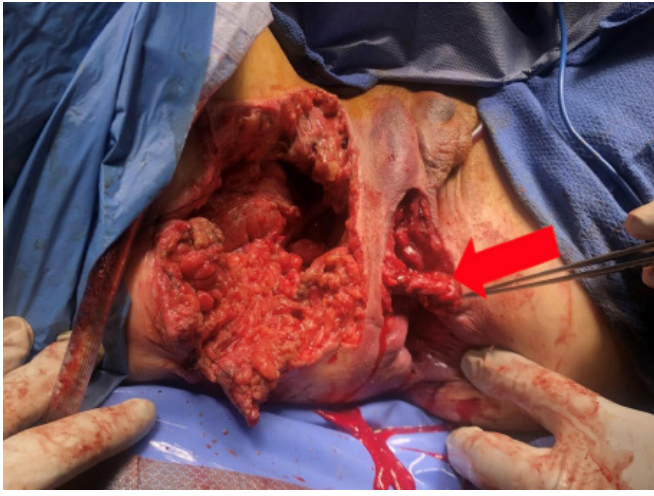
Intraoperative photograph showing the primary repair of the anterior rectal wall defect (arrow) down to the level of the disrupted anal canal, prior to sphincteroplasty.

Figure 3. Anal Sphincter Reconstruction. Published with Permission



Intraoperative photographs. (Left) Reconstructed anal canal following anoplasty. (Right) Completed overlapping internal and external anal sphincteroplasties (arrow indicating imbricated sphincter muscle).

Figure 4. Reconstruction of the Transverse Perineal Muscle. Published with Permission



the subcutaneous portion of the labial wound, deep to the repaired superficial transverse perineal muscle and adjacent to the anoplasty. The skin was approximated in layers using deep 0 Polysorb sutures, and the superficial skin was closed with an absorbable 2-0 self-retaining suture. Finally, a flexible synthetic skin-closing dressing was applied to reinforce the skin closure (Figure 5). Inspection of the lateral pelvic defect revealed avulsed levator ani muscles from the pubic ramus. Reimplantation of these muscles along the right pubic rami and obturator internus fascia was performed using 2-0 Maxon interrupted sutures.

Figure 5. Completed Anorectal and Initial Perineal Reconstruction. Published with Permission



Pelvic soft tissue reconstruction was completed on PTD 9 with the closure of the large lateral defect using a right inferior gluteal artery perforator (IGAP) flap for definitive perineal coverage (Figure 6). The patient also underwent extensive orthopedic surgeries on PTD 2, 5, and 9 to address her multiple fractures, including the right femur, anterior column acetabular fractures, right tibial plateau fracture, left superior and inferior pubic ramus fractures, ruptured pubic symphysis, left clavicle fracture, and left sacral ala fractures.

Figure 6. Definitive Perineal Reconstruction with IGAP Flap. Published with Permission



The patient was discharged on PTD 30 to a pediatric long-term acute care facility. Outpatient fluoroscopic defecography performed at 5 months post-injury demonstrated appropriate pelvic floor function during cough and forced evacuation, with no evidence of rectocele, enterocele, dyskinesia, intussusception, or anismus. Minor stress urinary incontinence with cough was noted, and there was no significant change in pelvic floor elevation with Kegel maneuver. Follow-up anal manometry revealed normal resting anal pressures, normal rectal sensation, and appropriate balloon filling capacity, but decreased maximal squeeze pressures and an absent anorectal inhibitory reflex. She was deemed eligible for ostomy takedown at 6 months post-MVC but deferred this until 9 months post-injury due to scheduling preferences. At her last follow-up, 15 months post-injury, all pelvic reconstructions were fully healed and demonstrated good functional outcomes (Figure 7).

Figure 7. Healed Perineal Reconstruction at Long-Term Follow-up.
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Discussion

Perineal trauma, while rare, poses significant management challenges due to the intricate anatomy of the region and the potential for severe, long-term functional impairment. The majority of literature on perineal injuries focuses on obstetric trauma (typically lower-energy, blunt mechanisms) or military blast injuries (often higher-energy, penetrating trauma), leaving a relative paucity of data specifically addressing the management and functional outcomes of perineal injuries resulting from motor vehicle collisions (MVCs).

The energy transfer and mechanism of injury are critical considerations in perineal trauma. Obstetric injuries generally involve lower-energy forces such as stretching, compression, and tearing, resulting in varying degrees of perineal tears or lacerations, typically localized and considered blunt trauma.¹ In contrast, blast injuries represent high-energy trauma, capable of causing extensive, multi-tissue damage to the perineal region. Military blast trauma is

characterized by a primary injury from the initial shock-wave, secondary injuries from shrapnel or debris penetration, and tertiary injuries due to forceful displacement of the body.² MVCs often fall within an intermediate energy spectrum, with rapid deceleration leading to substantial energy transfer, potentially causing multisystem injuries, complex fractures, extensive soft tissue damage, and organ injury. Furthermore, MVCs can involve penetrating trauma from vehicle components or debris. Consequently, perineal injuries sustained in MVCs may necessitate tailored management strategies to optimize functional recovery.³

While established principles guide the treatment of obstetric and military-related perineal injuries, there is limited understanding of how precise anatomical reconstruction impacts long-term functionality in the context of MVC-related perineal trauma. Current literature lacks detailed protocols and guidelines specifically for managing such injuries. This report aims to address this gap by presenting a case of complex, severe perineal trauma in a 17-year-old female following an MVC, where a meticulous, multidisciplinary approach with an emphasis on precise reattachment of vital anatomical structures resulted in successful functional restoration.

The early management of this patient adhered to established trauma principles, emphasizing prompt hemodynamic resuscitation, pelvic stabilization (pelvic binder followed by orthopedic fixation), staged surgical procedures, and proximal fecal diversion.⁴ The importance of fecal diversion in preventing septic complications, particularly in cases involving extensive contamination or significant tissue loss as seen here, is underscored by multi-institutional studies on perineal trauma.⁵ The decision to perform a diverting loop ileostomy, rather than a colostomy, aligns with current evidence suggesting that ileostomy may be preferable in scenarios with significant perineal trauma and contamination, where a colostomy might pose a greater risk for infectious complications in extensively contaminated wounds.^{6,7}

The reconstruction of severe perineal injuries following trauma is a formidable surgical undertaking, given the complex regional anatomy and the critical functions of the involved organs. General recommendations advocate for prompt and meticulous repair of pelvic floor musculature and anal sphincters to optimize functional outcomes.^{8,9} Delayed repair has been associated with increased fibrosis and impaired sphincter function, potentially compromising long-term continence.^{5,8} Furthermore, levatoroplasty, the repair and reinforcement of the levator ani muscle

complex, has been shown to bolster pelvic floor integrity, thereby reducing the long-term risks of organ prolapse and repair breakdown.^{6,7} In this instance, definitive anorectal and pelvic floor reconstruction was initiated on PTD 3, with final soft tissue flap coverage completed on PTD 9, after her major pelvic and femoral orthopedic injuries had been surgically stabilized.

The primary pelvic reconstruction focused on restoring normal anatomy and included repair of the anterior rectal defect, overlapping internal and external anal sphincteroplasties, anoplasty, and levatoroplasty. This sequential approach was critical for re-establishing the integrity of the anorectal cylinder, providing pelvic stability, and augmenting the perineal soft tissue defect to enhance the potential for functional recovery. The adjunctive use of biologic materials, specifically an extracellular urinary bladder matrix, was chosen to promote soft tissue healing and regeneration. EBMs are thought to provide a scaffold that encourages cellular migration, angiogenesis, and myofibroblast differentiation, potentially improving the quality and strength of the repair.¹⁰⁻¹²

The extensive soft tissue defect remaining after initial debridement and anorectal reconstruction necessitated robust coverage. Tissue flaps offer significant advantages over traditional methods like partial closure or healing by secondary intention, which are often complicated by prolonged healing times, wound contracture, and challenging nursing care. The utilization of a right inferior IGAP flap provided durable, well-vascularized tissue for complete coverage of the large perineal defect, with the added benefit of relatively minimal donor site morbidity.

Fortunately, our patient experienced an excellent return of pelvic organ function, as demonstrated by radiographic (fluoroscopic defecography) and manometric studies, and most importantly, by her clinical progress. This successful restoration of function emphasizes the critical importance of a coordinated, multidisciplinary approach involving meticulous surgical planning and execution.

Conclusion

This case demonstrates that early and definitive reconstruction of severe blunt perineal injuries, even those resulting from high-energy motor vehicle collisions, can achieve excellent functional and aesthetic outcomes. The successful application of advanced reconstructive techniques, including meticulous anatomical repair of the anorectal complex,

levatoroplasty, utilization of biologic adjuncts, and robust soft tissue coverage with vascularized flaps, represents a significant advancement in the comprehensive management of complex perineal trauma.

Lessons Learned

Severe blunt perineal trauma sustained in motor vehicle collisions presents a rare and unique surgical challenge, demanding a highly coordinated, multidisciplinary approach for optimal functional recovery. The present case exemplifies several key principles: the importance of early fecal diversion to minimize contamination and protect complex repairs; the necessity for prompt and meticulous reconstruction of the anorectal complex, including sphincter and levator ani muscles, to preserve continence and pelvic floor integrity; and the potential benefits of biologic adjuncts in enhancing soft tissue healing in contaminated or compromised wounds. Furthermore, advanced reconstructive techniques, such as levatoroplasty and coverage with an IGAP flap, proved essential in achieving anatomical restoration and durable wound closure. It is plausible that early, definitive soft tissue flap coverage contributed to expedited wound healing and reduced infectious complications. While not formally implemented in this case beyond standard postoperative care, structured, specialized postoperative pelvic floor rehabilitation may further enhance long-term functional outcomes in such patients. This case emphasizes the need for individualized, staged management strategies to optimize both surgical and functional results in these devastating injuries.

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