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Medical-Social and Forensic-Medical Aspects of Mechanical Trauma to the External Genital Organs in Males

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Abstract The article provides a literature review on the nature, prevalence, clinical and morphological characteristics, complications, and consequences of mechanical traumas affecting various structures of the external genitalia in males. Unified and widely accepted classifications of injuries to specific structures of the male external genital organs are presented. Modern approaches to the diagnosis and treatment of these organ injuries are outlined. Long-term consequences of injuries that significantly impact the quality of life of the affected individuals are identified. Current and insufficiently studied forensic-medical issues related to male genital trauma are highlighted. Prospects for further research in this area are identified.

Keywords Males, External genital organs, Injuries, Morphology, Consequences, Forensic aspects

1. Introduction

Traumatic injuries to the genital organs in humans represent a highly socially significant issue, as the consequences of these injuries can lead to infertility, persistent pain syndromes, and sometimes hypogonadism and erectile dysfunction in males, significantly reducing the quality of life of the affected individuals [22,31].

Timely diagnosis, development of advanced organ-preserving treatment methods, as well as rehabilitation of patients with genital trauma and determination of the mechanism of injury formation of these structures, remain the most relevant problem for many branches of modern medicine, including urological surgery, obstetrics-gynecology, surgery, pediatric surgery, medical psychology, and forensic medicine [2,3,4, 17,19,30,33].

Traumatic injuries to the reproductive organs in humans, whether intentional or accidental, inevitably undergo forensic examination. This examination requires establishing the nature, timing, severity, and mechanism of injury to the reproductive structures and organs. In cases of fatal trauma, determining the cause of death with substantiation of its thanatogenesis is also necessary. Despite this, literature dedicated to studying these and other forensic-medical aspects of genital injuries is scarce [13]. The morphological characteristics of mechanical injuries to specific structures and organs of the reproductive system are insufficiently studied for the substantiation of the injury mechanism. Criteria for forensic qualification of complicated and uncomplicated genital injuries are not well-defined. The thanatogenesis of fatal outcomes of injuries to these structures is not sufficiently substantiated, thus necessitating targeted research on the forensic-medical aspects of injuries to reproductive organ structures.

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2. Objective

Conducting a literature review on the epidemiology, classification, clinical and morphological characteristics, and consequences of trauma to the external genital organs in males, along with analyzing the extent of investigation into the forensic-medical aspects of these conditions.

3. Materials and Methods

Scientific and educational literature from recent years has been studied concerning the medical-social and forensic-medical aspects of genital trauma in males.

4. Results and Discussion

Mechanical damage to the external genitalia in males occurs more frequently than in females. This is due to the anatomical characteristics of these structures in men and is

associated with the fact that men often perform hazardous heavy work and engage in comparatively more hazardous sports activities than women. In addition, injuries to the external genitalia in men may be observed in individuals with mental disorders, as well as in people with pathological sexual orientations, or may be associated with bites; they may also occur during reconstructive surgeries, known as iatrogenic injuries [6,9,10,11,12,13].

The perineum and external male genital organs are considered reflexogenic zones, and their damage undoubtedly affects the reproductive and fertilizing function, i.e., the reproduction of men. Moreover, remote adverse outcomes of genital trauma, along with emotional stress, structural changes in the testes, chronic somatic diseases, and the use of medications affecting the generative function, create a serious demographic problem [6,9,10,11,12,13].

Damage to the external genital organs in males includes injuries to the penis, scrotum, testicles, and its appendage. In the structure of injuries to the external genital organs, injuries to the penis account for approximately 50%, constituting 30-50% of all injuries to the genitourinary system organs [24].

According to the classification of scrotum and testicle injuries by the European Association of Urology (2007) and the classification by the Organ Injury Scaling Committee of the American Association for the Surgery of Trauma (2006), the following degrees of scrotum and testicle injuries are distinguished: A. Scrotum injuries - concussion (I); tear <25% of the scrotum diameter (II); tear >25% of the scrotum diameter (III); skin detachment of the scrotum <50% (IV); skin detachment of the scrotum ≥50% (V). B. Testicle injuries: concussion or hematoma (I); subclinical rupture of the tunica albuginea (II); rupture of the tunica albuginea with loss of parenchyma <50% (III); rupture of parenchyma with loss of parenchyma (IV); complete destruction (smashing) of the testicle or detachment (V). Injuries to the scrotum and testicle are often identified in combined injuries of the abdomen, pelvis, and limbs. Closed injuries to the scrotum and its organs account for 9-13% of all genitourinary injuries. Among scrotum and its organs injuries, closed injuries predominate (80%) over open injuries (19.4%). Self-inflicted injuries (0.5%) and dislocating testicle dislocations (0.1%) are also distinguished. For I-II degree injuries, conservative therapy is proposed, for III-IV degree injuries, organ-preserving surgery is performed, and V-degree injuries are considered an absolute indication for surgery.

It should be noted that dislocating testicle dislocations are more common among motorcyclists involved in traffic accidents due to a sudden and sharp impact of the groin against the gas tank, in which the testicle is pushed upwards along the inguinal canal; however, the testicle is usually not damaged in this process. Closed injuries to the scrotum and its organs occur as a result of a direct blow from blunt objects or collisions of the body with such objects, for example, during falls or in conditions of compression (crushing), stretching, and entrapment of the scrotum. In these circumstances, the scrotum is more often injured than its organs because under the influence of force, there is a reflex contraction of the muscles lifting the testicles, causing the testicles to migrate out of the zone of the injuring force. Open injuries to the scrotum and its organs are wounds of various origins, which in peacetime do not exceed 1% of all injuries to the genitourinary system organs. Wounds can be within the soft tissues of the scrotum or with damage to its organ structures, especially wounds caused by sharp objects. Injuries to the testicles can lead to shock, and in the long term, necrosis of the testicle can develop, leading to testicular atrophy, which disrupts the fertilization function [23,44]. According to Al-Wadaih M.A.A. et al. (2022), injuries to the scrotum organs were identified in 72.2% and injuries to the penis in 27.8% of patients. Scrotum injuries occurred with testicular rupture in 37.5% of cases and without testicular rupture in 35% [3].

Contusion of the external genital organs – closed trauma to the external genital organs with possible damage to the organs of the scrotum, intrascrotal hemorrhage, and hematoma formation (ICD-10 code S 30.2). Contusions of the external genital organs and injuries to the scrotum may occur during sports injuries, falls, blows to the pubic area, road traffic accidents, etc. In cases of contusions to the external genital organs, bruising of the scrotal skin and penis is observed, accompanied by diffuse hematoma spreading to the suprapubic area and perineum, enlargement of the scrotum and penis, and in cases of testicular rupture, the intensity of bleeding increases [4].

According to S.K. Yarova et al. (2018), over the period from 2008 to 2017, specialists of the emergency andrological service in Moscow provided assistance to 414 patients with scrotal and its organ injuries. The age of the patients ranged from 18 to 79 years, with the majority being under 60 years old (91.6%). Testicular contusion was detected in 49.3% of the injured, testicular rupture in 26.6%, and complete testicular destruction in 1.4% of cases. Isolated contusion of the scrotum without involvement of its organs (testicle, appendage, spermatic cord) was found in 12.1% of patients. An open wound of the scrotum without organ damage was noted in 6.8% of cases, and in 3.9% of patients, there was a wound of the scrotum with organ damage. It was established that the origin of scrotal and its organ injuries was due to sports and domestic accidents in 37.7% and 36.5% of cases, respectively, while traffic accidents accounted for 12.8%, criminal trauma for 7.0%, and occupational trauma for 6.0%. It was noted that each type of trauma in patients presented a certain character and volume of injury to these structures. For example, in sports injuries, scrotal and its organ injuries developed due to impacts and crush injuries, such as being pinched by a bicycle saddle or pelvic bones, resulting in testicular contusions in 50.0% of cases, but without open wounds to the scrotum and testicle. Conversely, in domestic injuries, open injuries predominated, which were also often observed in occupational injuries [31].

Traumatic injury to the scrotal organs can lead to testicular rupture, hematocele, testicular dislocation, hematoma of the testicular membranes, testicular atrophy, and the development of infectious complications. Therefore, urgent surgical

intervention is required for testicular injuries. Traumatic injuries to the male external genitalia, particularly to the scrotum and its organs, in some cases can be extensive and may involve detachment of the scrotum and skin covering the penis. Shestakov A.M. et al. (2015) reported a clinical case where a 28-year-old male experienced complete traumatic detachment of the scrotum and skin covering the penis with the skeletonization of the scrotal organs, resulting from contact with a working potato harvester. It was noted that the patient climbed through the working potato harvester to clear it, and his shorts were caught in the machine.

In children, injuries to the scrotum and its organs account for about 7% of acute diseases and injuries. Most often, contusions and hematomas of the scrotum and testicles are identified in children, with testicular ruptures and their appendages found in 12% of cases. According to S.K. Yarova and R.A. Khromova (2019), among 414 adult patients admitted to the hospital with scrotal and its organ injuries, contusion of the testicle was present in 204 patients, testicular ruptures in 111 patients, and testicular crush injuries were detected in 6 patients. Of these, urgent surgery was performed on 54 (26.5%) injured patients. Among 39 (72.2%) patients, no complications were found, post-traumatic orchitis was observed in 5 (9.3%) patients, and 1 patient (1.9%) developed sclerosis as a result of orchitis [30].

According to the literature, in the majority of cases (up to 80%), injuries to the scrotum are accompanied by trauma to its organs, primarily the testicles, which become the main cause of oligospermia and infertility in affected men. Consequently, the improvement of treatment methods and the development of organ-preserving surgical techniques appear to be a pertinent task in modern urological surgery [20,27,28].

An open wound of the scrotum and testicles (ICD-10 code S 31.3) is a disruption of the integrity of the tissues of these structures, resulting from injuries by sharp or blunt objects, as well as from bites and gunshot wounds. Open injuries to the scrotum and testicles can be characterized by: no damage to the scrotal organs; testicular damage; testicular prolapse; spermatic cord injury; scrotal amputation; testicular dislocation. Injuries can be isolated or combined with trauma to the pelvic bones, urinary bladder, rectum, etc. In cases of open injuries to the scrotum and testicles, patients experience severe pain in the scrotum, bleeding from the wounds, and shock. More severe injuries to the testicles are detected in cases of transportation trauma. In cases of criminal trauma, the testicles are most often injured due to kicks to the groin or by sharp objects [29,31,39].

Traumatic testicular dislocations can be unilateral or bilateral. External or subcutaneous and internal dislocations are distinguished. External (subcutaneous) dislocations include pubic, femoral, inguinal, and penile dislocations under the skin. Internal dislocations include dislocations of the testicles into the inguinal, femoral canals, as well as intra-abdominal and intrapartition dislocations. Injuries to the scrotum and its organs often coincide with injuries to the penis, urethra, and other pelvic structures. In dislocating dislocations, the testicle sometimes twists in the area of the spermatic cord, which can create a false picture of cryptorchidism and cause acute circulatory disturbance. Testicular traumatic dislocation is most often observed in motorcyclists, especially when hit by the front of a large gas tank, as well as in cyclists involved in traffic accidents. It has been noted that the locations of testicular dislocations in injuries can be inguinal (50%), pubic (18%), canal (8%), penile (8%), intra-abdominal (6%), and inguinal (4%) areas. Approximately 25% of testicular dislocations may be bilateral [17,38,43].

Kazarov R.L. et al. (2019) provided a detailed description of the clinical and morphological manifestations of right-sided inguinal dislocation of the testicle in a motorcyclist involved in a traffic accident due to impact against the motorcycle's gas tank. The victim was found to have a hematoma of the anterior abdominal wall, a scalped wound at the base of the penis, hematoma of the scrotum and perineum, and dislocation of the right testicle into the middle third of the inguinal canal, where a hematoma of the appendages was detected in the tail area. Revision of the wounds and organs was performed, and the right testicle was fixed to the skin of the scrotum. The postoperative period proceeded smoothly, and the patient was discharged for outpatient treatment after 10 days [17].

The outcomes of traumatic testicular injuries can be favorable - preservation of the organ, and unfavorable - loss of the organ (orchidectomy), or post-traumatic sclerosis with loss of organ function. Orchidectomy may be performed in cases of purulent-destructive orchitis. Orchitis in trauma victims has three course variants: 1 - aseptic inflammation, where local reaction predominates (edema, hyperemia, pain); 2 - infectious orchitis, which is the main cause of orchidectomy after organ-preserving surgery on the testicle, where infection of the traumatized testicle can develop ascendingly; 3 - orchitis associated with the production of antisperm antibodies in the form of "sympathetic inflammation". Post-traumatic epididymitis without orchitis is almost non-existent. Post-traumatic sclerosis develops as a result of orchitis [21,29,30].

Yuldashev S.M. et al. (2011) presented the results of examination, treatment, and long-term outcomes of testicular and appendage injuries in 218 male individuals. The circumstances of the injuries were as follows: 40.5% - intentional trauma; 19.6% - sports trauma; 38.7% - household trauma; 2.2% - occupational trauma. The age of the patients ranged from 18 to 50 years. Operative treatment was performed on 108 injured individuals by the traditional method (control group), and organ-preserving surgery was performed on 110 patients with the addition of a 30% solution of hyaluronic acid. In the long term, patients who underwent organ-preserving surgery showed significantly faster restoration of basic spermogram parameters to normal levels compared to the control group [15,28].

In closed injuries to the external genital organs, damage to the spermatic cord is very rare because the spermatic cord is sufficiently protected, and therefore, in some cases, injuries

to the spermatic cord may be observed without requiring surgical intervention. Contusions and crush injuries to the scrotum are almost always accompanied by massive subcutaneous hemorrhagic infiltrations due to its abundant vascularity and loose connective tissue. Hemorrhages often spread to the penis, perineum, inner surfaces of the thighs, and sometimes to the anterior abdominal wall. Due to hemorrhaging, the scrotum acquires a dark cherry-blue color and a doughy consistency.

Penile injuries can be classified as closed (80%) or open (20%). Among closed injuries are contusions, fractures, dislocations, and compression of the penis. Open injuries include superficial wounds that do not reach the tunica albuginea, bites, and gunshot wounds to the penis. According to the European Association of Urology (EAU) classification of penile trauma (2007), there are five severity levels of penile injuries: 1 - tissue rupture (contusion); 2 - rupture of the Buck's fascia (corpus cavernosum) without tissue loss; 3 - tissue rupture involving the glans penis with involvement of the external urethral orifice measuring less than 2.0 cm; 4 - partial penectomy, defect of the corpus cavernosum, or urethra exceeding 2.0 cm; 5 - total penectomy [classification of penile injuries by severity according to the European Association of Urology - EAU, 2007]. Penile injuries most commonly occur in the area of the foreskin, glans, and corpora cavernosa, which often coincide with scrotal trauma.

Contusions of the penis result from blunt force trauma or collisions of the genital area with objects. In penile contusions, the integrity of the soft tissues is not compromised; rather, the loose subcutaneous fatty tissue with abundant blood vessels is traumatized. As a result, soft tissue swelling, skin ecchymosis, and pain develop, with swelling possibly extending to the scrotum and perineum.

Penile fractures often (in about 60% of cases) occur as a result of a blow to the penis during erection. This type of trauma causes a rupture of the corpora cavernosa, although subcutaneous hematoma without tunica albuginea damage can also be observed, accompanied by increasing pain and the possibility of shock. Penile fractures may also occur during vigorous sexual activity due to impact of the penis against the pubic bones-symphysis or the perineum of the female partner. In 10-25% of cases, penile fractures are associated with injuries to the urethra and spongy tissue. Subcutaneous hematomas can spread to the scrotum, perineum, inner surface of the thighs, and anterior abdominal wall. The mechanism and circumstances of penile dislocation are similar to those of penile fracture. During penile dislocation, there is a rupture of the ligaments fixing the penis to the pelvic bones, resulting in displacement of the corpora cavernosa under the skin of the thigh, scrotum, and pubic bone areas, making the penis feel like an empty sac. Among all injuries to the external genital organs, penile trauma is identified in 30-50% of cases [5,8,32,33].

Open injuries to the penis result from the impact of blunt and sharp objects or from gunshot wounds, which may be associated with criminal or sexual acts, as well as animal bites, falls, sports injuries. In children, injuries to the penis may occur during play with sharp objects, and penile injuries can also occur during improperly performed circumcision surgery. Penile injuries may be superficial, not reaching the tunica albuginea, or deeper; often, the frenulum of the penis is damaged, accompanied by significant bleeding and pain. Extensive penile wounds lead to skin and corpora cavernosa defects. Bite wounds to the penis are characterized by poor healing, often resulting in infected complications. The forceful impact of blunt objects through clothing on the area of the penis can lead to the formation of a scalped wound, accompanied by intense pain, traumatic shock, and significant bleeding.

According to Al-Vajih M. S. et al. (2022), penile injuries often occur without urethral damage in 60% of cases and with urethral damage in 40% of cases. The authors propose four groups of genital injuries: isolated fractures of the penis; penile fracture with urethral rupture; injuries to the scrotal organs without testicular rupture; injuries to the scrotal organs with testicular rupture. In cases of penile trauma with and without urethral rupture, 75% of the affected individuals experienced changes in penile configuration in the remote period, such as curvature of varying degrees, depending on the nature of the injury. Dysuria was more commonly observed with urethral rupture (87.5%) compared to penile trauma without urethral rupture (16.6%). Erectile dysfunction in the remote period of trauma was more frequent (67%) in cases of scrotal trauma and in individuals with penile fractures with urethral damage (62.5%). Symptoms of lower urinary tract were observed in 75% of patients with penile trauma and urethral damage, and 37.5% experienced worsened urinary quality due to weakened urine stream, negatively impacting their quality of life [3]. The tunica albuginea of the corpus cavernosum of the penis is resistant to traumatic effects, with a thickness of up to 2.5mm, consisting of minimally stretchable connective tissue. During erection, the thickness of the tunica albuginea decreases to 0.25-0.5mm, making it susceptible to mechanical injury. False penile fracture, or penile contusion, is also identified, occurring in 4-10% of all penile traumas, involving rupture of the superficial veins of the penis and its ducts, leading to hematoma formation. In the post-traumatic period, this condition may lead to post-traumatic thrombophlebitis of the superficial vein, known as Mondor's disease. Rupture of the corpus cavernosum of the penis is sometimes associated with rupture of the anterior urethra, forming a urohematoma [8,34,35,37,40].

One of the most severe penile traumas is traumatic amputation, observed in cases of suicidal actions by individuals with mental disorders, as well as in combined traumas of the genital organs and pelvis. Regardless of the circumstances of the injury, penile amputation is a severe physical and psychological trauma for the affected individuals, causing mental suffering and impacting the quality of life of men [1,8,25].

Almost all penile traumas require urgent medical assistance, often surgical. Kazarov R. L. et al. (2016) provide clinical observations based on the results of surgical treatment of two

patients after 10 hours of penile trauma. The first case involved entrapment of the base of the penis by a metal ring, which the patient, who was not under psychiatric care, had been using to enhance sexual performance. The ring was difficult to remove from the base of the penis and required sawing with the assistance of an emergency services worker. Subsequently, there was a reduction in penile discoloration and swelling, a urethral catheter was placed, sedimentation was noted at the site of the ring, and no cavernous body injuries were detected. The catheter was removed on the 7th day, and the patient was discharged for outpatient treatment. In the second case, a 32-year-old patient had linear wounds on the dorsal and ventral surfaces of the penis, up to 5 cm in length, with smooth edges. According to the patient (who was also not under psychiatric care), while intoxicated with alcohol, he cut the glans penis with scissors, motivated by the belief that "after the wounds healed, the penis would increase in size." A defect on the frenulum of the penis with minor bleeding was identified in the area of the wound on the dorsal surface. There were no injuries to the cavernous bodies or skin wounds of the penis. A bandage was applied, and the patient was discharged for outpatient treatment [16].

There are reports in the literature of fatal outcomes due to penile trauma with impaired local and organ blood circulation. It is noted that a 47-year-old male, for unknown reasons, self-tied his penis approximately 2 days before admission to the hospital. As a result, the penis swelled and turned dark blue, and he began to urinate involuntarily. He was admitted to the surgical department and biological death occurred after 14 hours. Forensic examination of the body revealed phlegmon of the penis, scrotum, thrombosis of the iliac veins and pelvic veins with inflammation of the tissues of the small pelvis, and pulmonary artery thromboembolism [18].

Traumatic dislocation of the penis, compared to other types of trauma to the external genital organs, occurs relatively rarely. Dislocation of the penis is characterized by the disruption of the integrity of the skin and the penile ligamentous apparatus, accompanied by displacement of the penis into the scrotum, under the skin of the thigh, or into the pubic region. In 80% of cases, this condition arises as a result of blunt force trauma to the penis, scrotum, and perineum. Dudarev V. A. et al. (2021) describe a clinical case of a 60-year-old patient with a subcutaneous dislocation of the penis into the pubic region, resulting from a blow with a log to the groin area. The patient was admitted to the urological department on the 7th day after the trauma. In the area of the penis dislocation - in the pubic region, a purulent-necrotic infiltrate had formed with the spread of the infiltrate to the area of the penis. Surgical treatment was performed, and the patient was discharged for outpatient treatment on the 8th day after the operation. In this case, detachment of the preputial tissues from the glans along the coronal sulcus of the penis occurred, along with rupture of the ligaments fixing the organ and its dislocation under the skin of the pubic region. In the remote period after the trauma, preservation of erectile function of the organ was noted [14].

5. Conclusions

1. Traumatic injuries to the reproductive organs in humans are the most significant medical and social problem, the consequences of which can lead to infertility and significantly reduce the quality of life of the affected individuals. Injuries to these structures are most commonly observed in men, which is due to the anatomical characteristics of these organs in males.
2. Mechanical damage to the external genital organs in males includes injuries to the scrotum, testicles, epididymis, and penis. Based on anatomical characteristics, injuries to the external genital organs can vary in severity, with or without involvement of internal structures, and penile trauma can be classified into 5 degrees of severity according to the classification of the European Urological Association (EUA) (2007).
3. Almost all types of male genital injuries are currently classified in corresponding clinicomorphological classifications, with precise determination of anatomofunctional types and severity of injuries to these structures. The use of these classifications in forensic medical examinations of male genital injuries significantly facilitates the resolution of forensic medical tasks and increases the quality and reliability of forensic medical conclusions.
4. Forensic medical aspects of male genital injuries require further improvement in establishing the mechanism, severity, timing of injuries, and in cases of fatal outcomes, in substantiating the cause of death and the thanatogenesis of the trauma.

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