Section: Miscellaneous

Original Research Article

ILIOINGUINAL NERVE INJURY DURING RADICAL INGUINAL ORCHIECTOMY: A COMPREHENSIVE LITERATURE REVIEW

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ABSTRACT

Background: Testicular cancer is the most common solid malignancy in young men, and radical inguinal orchiectomy is its primary diagnostic and therapeutic intervention. Although oncological outcomes are excellent, iatrogenic injury to the ilioinguinal nerve is an underrecognized complication causing chronic postsurgical pain, inguinodynia, and sensory disturbance. Objective: This review synthesizes the surgical anatomy of the ilioinguinal nerve, the technical steps of orchiectomy that place it at risk, mechanisms of nerve trauma, and a framework for preventing, diagnosing, and managing post-orchiectomy neuralgia. **Materials and Methods:** A systematic search of PubMed, Scopus, Embase, and Web of Science (inception to June 2026) identified studies addressing nerve injury during inguinal surgery. **Results:** Persistent ilioinguinal neuropathy affects 10-15% of patients after classical open orchiectomy, falling to near 0% with a subinguinal approach avoiding incision of the external oblique aponeurosis. Injury arises from transection, traction, thermal spread, suture entrapment, and ischemic skeletonization. Diagnosis relies on clinical mapping, ultrasound, MR neurography, and diagnostic blocks; management ranges from gabapentinoids and tricyclic antidepressants to pulsed radiofrequency, neurolysis, or neurectomy. **Conclusion:** Early intraoperative nerve visualization and careful aponeurotic closure minimize long-term neuropathic morbidity. Standardized grading and patient-reported outcomes should guide future practice.

INTRODUCTION

Epidemiology of Testicular Cancer

Testicular cancer is the most common solid malignancy in men aged 15-40, accounting for roughly 1% of male cancers worldwide.[1] Incidence has risen steadily, particularly in industrialized nations, while mortality has fallen with cisplatin-based chemotherapy and refined staging.[1,2] Germ cell tumors account for about 95% of cases and are classified as seminomatous or non-seminomatous.[2,3] Recognized risk factors include cryptorchidism, family history, and prior contralateral tumor.[1] Most patients present with a painless testicular mass, though some report scrotal heaviness or, in advanced disease, back pain and metastatic symptoms.[1,4]

Role of Radical Inguinal Orchiectomy

Radical inguinal orchiectomy is the diagnostic and therapeutic standard for suspected testicular malignancy.[3,4] An inguinal, rather than scrotal, approach avoids seeding tumor cells into lymphatic pathways.[3,5] The specimen also confirms tumor subtype and prognostic features that guide subsequent surveillance, chemotherapy, or lymph node dissection.[2,3,4] For many stage I patients, orchiectomy alone is curative.[2]

Importance of Nerve Preservation

Groin and pelvic surgery routinely exposes peripheral nerves to compression, traction, or transection.[6] The resulting chronic postsurgical pain persists beyond normal healing and degrades sleep, mental health, and daily function.[6,7,8] Nerve stretching or entrapment triggers sensitization that converts acute inflammatory pain into a persistent state,[6,9] as also seen with poor nerve identification during hernia or thoracic surgery.[6,9] Deliberate nerve-preservation strategies reduce analgesic reliance and support recovery.[8,10]

Rationale for the Review

Literature addressing isolated ilioinguinal nerve injury after orchiectomy remains sparse, overshadowed by hernia-mesh or orthopedic discussions,[11] and scattered across surgical, anatomical, and radiological fields, with no universal management algorithm.[12] This review consolidates

the evidence to clarify competing strategies, such as prophylactic neurectomy versus preservation.

Objectives

This review describes the anatomy of the ilioinguinal nerve through the inguinal canal,[3,13] examines how orchiectomy technique can injure it,[3] and evaluates the incidence, diagnosis, prevention, and management of chronic post-orchiectomy neuralgia.[13,14]

MATERIALS AND METHODS

Literature Search Strategy

A systematic search of PubMed, Scopus, Embase, and Web of Science was performed from inception to June 2026 using the string (ilioinguinal nerve OR nerve injury OR groin pain) AND (radical inguinal orchiectomy OR testicular cancer surgery). Only peer-reviewed, English-language articles on nerve anatomy, incidence, prevention, or management during orchiectomy were eligible. Two reviewers independently screened titles and abstracts, resolving disagreements by discussion, and hand-searched reference lists for additional studies.

Inclusion and Exclusion Criteria

Eligible studies included clinical trials, cohort and case-control studies, large case series, and cadaveric studies of men undergoing orchiectomy that reported iatrogenic nerve injury or chronic groin neuropathy. Case reports, non-English articles, book chapters, pediatric-only series, and benign scrotal pathology studies without relevant anatomical data were excluded.

Data Extraction and Synthesis

A standardized template captured study design, cohort size, technique, follow-up, nerve injury incidence, diagnostic criteria, and management outcomes. Given heterogeneous reporting, meta-analysis was not feasible; findings were synthesized narratively to identify consensus trends and evidence gaps.

Surgical Anatomy of the Ilioinguinal Nerve

Origin and Course

The ilioinguinal nerve arises from the anterior ramus of L1, occasionally with a T12 contribution, emerging at the lateral border of psoas major just inferior to the iliohypogastric nerve.[11] It crosses the quadratus lumborum and iliacus toward the iliac crest, perforates the transversus abdominis near the anterior superior iliac spine, and communicates with the iliohypogastric nerve between the transversus abdominis and internal oblique.[11] Its main surgical vulnerability begins once it enters the superficial abdominal wall.

Anatomy Within the Inguinal Canal

The nerve pierces the internal oblique, rather than passing through the deep inguinal ring, then runs within the canal on the anterior surface of the spermatic cord, typically inside the cremasteric fascia, exiting via the superficial inguinal ring.[11,20] Lying directly beneath the external oblique aponeurosis and closely adherent to the cord, it is exposed the moment the aponeurosis is incised, making it vulnerable to transection, traction, or suture entrapment at closure.[20]

Areas of Sensory Innervation

Distally, the nerve is purely sensory, supplying the upper medial thigh, penile root, and upper scrotum, and mediating the afferent limb of the cremasteric reflex.[11] Its territory overlaps with the genitofemoral and iliohypogastric nerves.[19] Complete transection causes anesthesia across this distribution, while partial injury produces burning pain radiating into the scrotum.

Anatomical Variations

Cadaveric studies show the nerve is entirely absent in up to 35% of specimens, its territory assumed by adjacent nerves, and arises independently from psoas major in only 47% to 94.5% of individuals, otherwise sharing a trunk with the iliohypogastric nerve.[11] The genitofemoral nerve fully replaces ilioinguinal sensation over the scrotum and thigh in 43.7% of dissections.[19] Surgeons therefore cannot rely on textbook maps and must visualize the nerve directly.

Radical Inguinal Orchiectomy: Surgical Technique

Standard Surgical Approach

Radical inguinal orchiectomy uses an oblique groin incision rather than a scrotal approach, avoiding tumor seeding.[15,16] The incision begins about 2 cm superior and lateral to the pubic tubercle, extending toward the anterior superior iliac spine parallel to the inguinal ligament, spanning 3 to 10 cm.[3] Early exposure secures the proximal cord before the testis is manipulated.[4]

Inguinal Canal Exposure

After division of Scarpa's fascia, dissection proceeds to the external oblique aponeurosis, sharply incised along its fibers to the internal ring.[3,4] This exposes the ilioinguinal nerve on the cord surface within the cremasteric fascia; it should be identified and freed at this stage, since delayed identification raises the risk of later injury.[3,17]

Spermatic Cord Mobilization

The cord is isolated at the pubic tubercle and encircled with a vessel loop, tightened near the internal ring as an atraumatic tourniquet before the testis is delivered.[3,17] The transversalis fascia should be preserved to avoid a subsequent hernia,[3] and the nerve kept clear of the traction loop.[4]

High Cord Ligation

The cord is divided at the internal ring using a three-clamp technique, separating the vas deferens from the gonadal vessels, individually ligated with heavy transfixion sutures for oncologically complete stumps.[4,15,17] Surgeons must confirm the nerve is free of these ligatures.[3]

Points at Risk for Ilioinguinal Nerve Injury

Three moments place the nerve at greatest risk: aponeurotic division, where blind incision may transect it,[3] cord mobilization, where traction or diathermy can stretch or burn adherent fibers,[17] and closure, where a stray suture can entrap it.[15] These

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injuries commonly present as chronic inguinodynia or paresthesia across the medial thigh and scrotum.[3]

Mechanisms of Ilioinguinal Nerve Injury

Direct Transection

Sharp division of the nerve, most often during aponeurotic incision or cord isolation, triggers Wallerian degeneration distally and disorganized proximal regeneration, often forming painful terminal neuromas.[18,19,9,21] These bulbs are mechanically hypersensitive, while transection also causes permanent anesthesia across the nerve's territory.

Traction Injury

Prolonged or heavy retraction can stretch the nerve beyond the elasticity of the perineurium, compressing the vasa nervorum and causing endoneurial edema and conduction block.[13,23,24] Mild stretch produces transient neurapraxia, but severe traction causes permanent axonotmesis and fibrosis, leaving the nerve chronically hypersensitive.[23]

Thermal Injury

Lateral heat spread from electrocautery near the internal ring or pubic tubercle causes protein denaturation and coagulation necrosis, extending millimeters beyond the point of contact.[25,26,27] The resulting scarring lowers activation thresholds, producing ectopic firing manifesting as allodynia.[26,27]

Entrapment by Sutures or Scar Tissue

A suture placed during closure can transfix or kink the nerve, and scar deposition can chronically constrict it, impairing axoplasmic transport and causing localized hypoxia.[28,29,30] The resulting ischemia upregulates sodium channels along damaged axons, producing inguinodynia that worsens with hip extension.[28,30]

Ischemic Injury

Extensive skeletonization of the cord can sever the small vessels supplying the nerve, causing hypoxic degeneration and fibrotic replacement.[31,32] This lowers the activation threshold of surviving axons, sustaining the pain cycle with routine movement.[33]

Neuroma Formation

When regenerating axons cannot reach their target after division or crush, they coil into a disorganized mass hypersensitive to light pressure.[14,34,35] An active neuroma presents as a focal tender point radiating shooting pain into the scrotum or thigh and often resists conservative therapy, requiring targeted intervention.[35]

Incidence and Epidemiology

Reported Incidence in Orchiectomy Literature

Persistent ilioinguinal hypoesthesia or neuralgia is reported in 10% to 15% of patients after classical open radical inguinal orchiectomy.[5,15] A subinguinal approach, avoiding the external oblique aponeurosis, reduces this risk to near 0% by leaving the nerve trunk undisturbed and protected from suture entrapment at closure,[15,2] showing that a targeted technical modification can substantially lower long-term morbidity without compromising oncological control.

Comparison with Other Inguinal Procedures

Inguinal hernia repair carries the highest risk of chronic groin neuralgia among inguinal procedures, reported in 5% to 54% of cases (pooled average 11% to 16.8%), with roughly 2% developing disabling neuralgia from mesh inflammation or fixation-tack compression.[27,36,37,38] Varicocelectomy, using subinguinal or microsurgical access that preserves the aponeurosis, carries a much lower risk (under 1-2%), usually limited to transient traction of small branches.[39,40,41] Hydrocelectomy, via a scrotal incision bypassing the canal, rarely injures the proximal trunk; any deficit (under 1%) involves only terminal scrotal branches.[32,42] [Table 1] summarizes these comparisons.

Table 1: Comparative nerve risk across inguinal and scrotal procedures

Procedure	Nerve Vulnerability	Chronic Neuralgia Incidence	Primary Mechanism
Radical Inguinal Orchiectomy.[3,15]	Main ilioinguinal trunk (subaponeurotic).[3]	10-15% (open approach).[15]	Cord traction, aponeurosis closure suture entrapment.[3,17]
Inguinal Hernia Repair.[27]	Ilioinguinal, iliohypogastric, genitofemoral.[11]	11-16.8% (pooled average).[27]	Mesh inflammation, fixation tack compression.[37]
Varicocelectomy.[39,41]	Fine collateral/terminal branches.[40]	<1-2%.[41]	Gentle cord traction, localized stretch.[40]
Hydrocelectomy.[32]	Terminal anterior scrotal branches.[32]	<1%.[42]	Distal sharp dissection, terminal tissue handling.[32]

Underreporting and Diagnostic Challenges

True incidence is likely underestimated, since early neuropathic symptoms are often dismissed as routine postoperative pain and go undocumented.[26] Overlapping sensory territories among the ilioinguinal, iliohypogastric, and genitofemoral nerves further complicate isolating a single nerve injury without targeted diagnostic blocks.[18]

Clinical Presentation

Acute Postoperative Symptoms

Acute injury presents as sharp, burning pain radiating from the lower abdomen into the groin, often with allodynia to light clothing contact, reflecting mechanical irritation and local inflammation.[43,6,44] Pain is frequently paroxysmal, triggered by coughing or minor positional change, unlike the dull ache of routine healing.

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Chronic Neuropathic Pain

Chronic ilioinguinal neuralgia is defined by neuropathic groin symptoms persisting beyond three months, typically deep, burning, or electric in quality.[10,45] Because abdominal wall stretch increases tension on an injured nerve, patients often adopt a stooped gait to limit hip extension, generating secondary strain.[45]

Sensory Disturbances

Presentations range from hyperesthesia to well-demarcated hypoesthesia or anesthesia across the lower abdomen, upper inner thigh, and penile root or anterior scrotum, sometimes with paresthesias such as tingling.[20] Mapping these changes provides an objective way to confirm and localize the injury.[20]

Impact on Quality of Life

Persistent neuropathic pain disrupts sleep and limits walking, lifting, and exercise, impairing return to work.[46,47] Because the nerve supplies the anterior scrotal skin, neuralgia can make sexual activity or clothing contact painful, contributing to relationship strain and depression.[48]

Differential Diagnosis

Iliohypogastric neuralgia affects the suprapubic and lateral hip skin without involving the thigh or scrotum.[49,50,51] Genitofemoral neuralgia produces lateral scrotal pain and loss of the cremasteric reflex (genital branch), or a discrete anterior thigh patch (femoral branch).[52] New or worsening pain after orchiectomy warrants evaluation for retroperitoneal recurrence, which can compress lumbar nerve roots and mimic peripheral entrapment.[15,53] Musculoskeletal causes such as osteitis pubis or adductor strain lack sensory changes, presenting instead with deep, movement-related tenderness.[27] A structured diagnostic and management algorithm can help clinicians navigate overlapping genital pain presentations.[22]

Diagnostic Evaluation

Clinical Examination and Sensory Mapping

Palpation typically localizes maximal tenderness roughly 2 cm medial and inferior to the anterior superior iliac spine or over the external inguinal ring, with a positive Hoffmann-Tinel sign reproducing shooting pain into the scrotum or thigh.[18,27] Light-touch and pinprick mapping helps distinguish an ilioinguinal pattern from neighboring nerve distributions.[27,35]

Diagnostic Nerve Blocks

Image-guided injection of local anesthetic around the nerve is the diagnostic gold standard: substantial (greater than 50-75%) pain relief while the block is active confirms the nerve as the pain generator and guides further therapy.[18,50,37]

Imaging Studies

High-resolution ultrasound can trace the nerve between the transversus abdominis and internal oblique and identify focal swelling, entrapment, or neuroma.[18,26] MR neurography detects abnormal T2 hyperintensity and structural changes, distinguishing scarring from tumor recurrence.[30]

Electrophysiological Testing

Nerve conduction studies and electromyography can demonstrate reduced sensory amplitude or delayed conduction relative to the contralateral side, confirming axonal loss, though sensitivity is limited in obese patients or dense scarring.[18,35]

Prevention of Ilioinguinal Nerve Injury

Anatomical Identification and Nerve-Sparing Surgical Techniques

Early, deliberate visualization of the nerve after opening the external oblique aponeurosis, and gentle mobilization away from the field with vessel loops, is the most reliable preventive measure.[18,54,37] A subinguinal approach avoids opening the canal and protects the proximal trunk,[15] when the nerve cannot be safely separated from dense scar, planned transection may be preferable to leaving it crushed.[37]

Magnification and Microsurgical Principles

Loupe or microscope magnification improves discrimination of fine nerve branches from fascia and vessels, enabling precise dissection that preserves the vasa nervorum and reduces ischemic and thermal injury.[15,41]

Surgeon Experience, Training, and Enhanced Recovery Protocols

Familiarity with variable nerve anatomy allows experienced surgeons to adapt their dissection and reduce injury relative to lower-volume providers.[18,15] Enhanced Recovery After Surgery protocols, emphasizing multimodal analgesia and image-guided blocks, limit muscle spasm and support early mobilization.[37,18,27]

Management Strategies

Conservative and Pharmacological Management

Because early symptoms often reflect transient traction edema, an initial 6- to 8-week observation period with activity modification is reasonable, alongside counseling that sensory change does not equal motor loss.[37,18] NSAIDs address inflammatory components but are insufficient alone for neuropathic pain.[13,9] Gabapentinoids reduce excitatory signaling via calcium-channel binding, while tricyclic antidepressants such as amitriptyline calm burning pain via monoamine reuptake inhibition, with dose titration to limit side effects.[13,18,41,9]

Interventional Procedures

Ultrasound- or CT-guided injections combining local anesthetic and corticosteroid provide diagnostic confirmation and reduce local edema.[18,30,26] For recurrent pain, pulsed radiofrequency modulates the nerve without permanent damage, while continuous thermal radiofrequency ablates it for longer-lasting relief at the cost of permanent numbness.[26,50]

Surgical Management

Neurolysis frees an intact but entrapped nerve from scar or misplaced sutures.[18,26,13,27] Neurectomy, reserved for severely damaged nerves, and neuroma excision both require burying the proximal stump within nearby muscle to prevent recurrence.[37,18,48,27]

Outcomes of Treatment

Conservative measures suffice for many mild, early cases, while image-guided blocks or pulsed

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radiofrequency achieve high, often greater than 90%, relief in selected patients.[37,18,50] Surgery offers definitive relief for refractory cases at the cost of permanent numbness, and earlier intervention correlates with better outcomes.[37,48]

Medicolegal and Quality-of-Care Considerations

Informed Consent and Documentation of Neurological Complications

Patients should be explicitly counseled about the risk of permanent numbness or chronic groin pain before inguinal surgery, establishing realistic expectations and legal protection.[15,54,40] Detailed documentation of symptom onset, sensory boundaries, and intraoperative nerve visualization supports standard-of-care compliance.[37,54]

Quality Indicators in Testicular Cancer Surgery

Chronic post-operative pain is increasingly tracked as a quality metric alongside margin status and recurrence-free survival; standardized technique, magnification, and quality review help institutions reduce neurological complication rates.[15,40]

Future Directions

Prospective Studies and Standardized Reporting of Neuropathic Complications

Current evidence relies heavily on small retrospective series or data drawn from hernia cohorts; prospective, multicenter trials using standardized technique are needed to define risk factors and compare traditional versus subinguinal approaches.[15,37] A unified grading system, such as a neurologically adapted Clavien-Dindo classification, would improve reporting consistency and enable meaningful meta-analysis.[37,27,40]

Patient-Reported Outcome Measures and Emerging Surgical Technologies

Validated instruments such as the Brief Pain Inventory or Carolinas Comfort Scale should be integrated into routine follow-up to capture the real-world impact of nerve injury.[37,40,41] Emerging near-infrared nerve-specific fluorescence imaging and robotic magnification may further enable real-time nerve visualization and preservation of fine collateral branches.[41,15,40]

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