



PEDIATRIC SURGERY *Update**

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Testicular Microlithiasis

Testicular microlithiasis (TM) is an ultrasonographic finding characterized by scattered calcium deposits within the seminiferous tubules. It appears as punctate, hyperechogenic foci, typically no larger than 1 to 3 mm, that do not produce posterior acoustic shadowing, a feature that distinguishes it from other testicular calcifications with different clinical significance. Its characteristic appearance, sometimes described as a "snowstorm" pattern, is usually identified incidentally during scrotal ultrasound performed for unrelated reasons, since the condition is painless and impalpable on physical examination. Since its first radiological description in a four-year-old boy in the early 1970s, and its later characterization by ultrasound years afterward, clinical interest in TM has steadily grown, driven largely by the uncertainty surrounding its possible association with testicular malignancy.

Histologically, TM is defined by the presence of laminated calcifications within the seminiferous tubule—rounded bodies made up of concentric rings that, according to the most widely accepted hypotheses, originate from the inability of Sertoli cells to fully phagocytose degenerated germ cell debris. This unremoved cellular material is thought to act as a nidus onto which glycoproteins and calcium salts progressively deposit, eventually forming the microcalcospherites visible on pathology. Other hypotheses point to local disturbances in mineral metabolism, genetic factors, or hormonal imbalances that impair androgen stimulation of Sertoli cells. None of these explanations is considered definitive, and the fact that laminated calcifications can also be found in histologically normal testes—as well as in cryptorchid testes or those harboring germ cell tumors—complicates the interpretation of their exact origin.

Radiologically, the diagnosis is established when five or more hyperechogenic foci are identified in a single ultrasound image, defining classic TM; below that threshold, the finding is termed limited TM. Distribution may be diffuse or focal, and involvement can be unilateral or bilateral, although in the pediatric population bilateral involvement and the classic pattern consistently predominate. This classification, while descriptively useful, does not substantially change follow-up recommendations, since current guidelines do not differentiate management based on subtype.

The prevalence of TM in children varies widely depending on the population studied, the diagnostic definition used, and the frequency of the transducer employed. Taken together, pediatric studies place the prevalence at approximately 2% in symptomatic children referred for ultrasound and somewhat above 4% in asymptomatic children, with a tendency

to increase with age and with more recent publication dates, likely reflecting the greater resolution of current ultrasound equipment. These figures are roughly comparable to those reported in asymptomatic young adults. TM is more frequently associated with certain benign conditions, such as undescended testis—where its prevalence can range from about 3% to 12%—a history of orchidopexy, varicocele, and hypospadias. A markedly elevated prevalence has also been described in children with Down syndrome, Klinefelter syndrome, and, particularly strikingly, McCune-Albright syndrome, where some series report figures above 20% and even close to 60%. Whether these associations reflect a genuine causal relationship or simply the fact that these patients are more likely to undergo repeated ultrasound studies remains unknown.

The most debated aspect of TM continues to be its relationship with testicular germ cell tumors. In adults, several systematic reviews have found an increased relative risk of testicular neoplasia in the presence of TM, particularly in subgroups with additional risk factors such as cryptorchidism, subfertility, or a personal history of testicular tumor; in contrast, asymptomatic patients without risk factors show no such increase. In the pediatric population, the picture is less clear. Large follow-up series agree that the vast majority of children with TM remain free of neoplasia during the observation period, with new tumor rates below 1% in most cohorts, although at least one large multicenter study has reported testicular tumor rates several times higher in children with TM compared with those without it, keeping the controversy open. One factor that complicates interpretation of these findings is the short duration of follow-up in most pediatric studies—usually between six months and a few years—which rarely extends beyond puberty, the point at which the incidence of germ cell tumors naturally begins to rise. In other words, a substantial part of the relevant risk window simply has not yet been observed in the children included in these studies.

When tumors have been reported concurrently with TM in prepubertal children, most are benign or premalignant lesions, and they are frequently associated with identifiable risk factors such as cryptorchidism or predisposing genetic syndromes. Frankly malignant tumors are far more common in adolescents older than thirteen years, an age at which the risk profile begins to approach that of young adults. Furthermore, the course of TM itself during childhood appears largely stable: in series with repeated ultrasound follow-up, only a minority of testes show a significant increase in microlith count, and a non-negligible proportion show a reduction or even complete resolution of the finding over time. No studies have been specifically designed to assess whether TM diagnosed before puberty is associated with infertility in adulthood, a gap that recent reviews highlight as a priority for future research.

Given this uncertainty, both European and American societies agree on one central point: isolated TM, without additional risk factors, does not require systematic ultrasound follow-up or routine serum tumor marker testing—measures that have not been shown to change outcomes and that, conversely, may generate unwarranted anxiety for the patient and family, along with unnecessary cost and exposure. Differences emerge when additional risk

factors are present—cryptorchidism, testicular atrophy, a personal or family history of testicular tumor, or predisposing genetic syndromes. European bodies tend to recommend periodic, generally annual, ultrasound surveillance along with education on self-examination from puberty onward; American guidelines instead prioritize education and monthly self-examination, reserving ultrasound for suspicious clinical findings, without establishing a formal imaging surveillance program. Both frameworks emphasize the importance of prompt ultrasound access when self-examination detects a change, as well as the need to plan the transition of pediatric patients with TM and risk factors to adult urology care upon reaching the age of majority, since it is precisely in that later stage that the risk of malignancy appears to become more clearly established.

Taken together, current evidence repositions childhood testicular microlithiasis as a generally benign and often transient finding, rather than a reliable marker of imminent oncologic risk. Its management should be individualized according to clinical context: reassurance and education in isolated cases, and closer—though not excessive—clinical surveillance in children who also present recognized risk factors. Fundamental questions remain unresolved, including whether TM detected in childhood represents the same biological entity observed in adults, what its true impact on future fertility might be, and whether extended follow-up beyond puberty would change current conclusions about malignancy risk. Answering these questions will require prospective, multicenter studies with follow-up extending into adulthood, something the literature available to date still lacks.

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Balanitis Xerotica Obliterans

Balanitis xerotica obliterans (BXO) is widely recognized as the male genital manifestation of lichen sclerosus, a chronic, progressive, sclerosing inflammatory dermatosis of unclear etiology that most commonly affects the foreskin, glans, and external urethral meatus in boys, and which may, when neglected, extend into the peripheral urethra, penile skin, and scrotum. The condition was first described in the nineteenth century under the term lichen sclerosus of the glans and prepuce, and the internationally adopted designation of balanitis xerotica obliterans was proposed several decades later to capture its three cardinal features: chronic inflammation of the glans (balanitis), a whitish, atrophic epithelial

appearance (xerotica), and an obliterative endarteritis. Although initially considered a disease of adulthood, its occurrence in children was documented by the mid-twentieth century, and it is now understood to be the leading cause of secondary, pathological phimosis in the pediatric population, distinguishing it from the far more common physiological non-retractility of the prepuce that resolves spontaneously with growth.

The true incidence of BXO in children remains difficult to establish. Population-based estimates from several countries place the prevalence at well under one percent of boys, generally in the range of roughly 0.1 to 0.4 percent, although figures differ according to region, circumcision practices, and how rigorously foreskins are submitted for histological examination. When the denominator is restricted to boys undergoing surgery specifically for phimosis, however, the proportion found to have BXO rises dramatically, with reported rates spanning from a small single-digit percentage to well over a third of cases, and in some surgical series approaching or exceeding forty percent. This wide variability reflects differences in diagnostic thresholds, in the routine (or selective) use of histology, and in the degree of clinical vigilance exercised by both referring practitioners and operating surgeons. A recurring theme across the literature is that incidence figures have risen over recent decades, a trend attributed less to a true increase in disease frequency than to greater awareness among clinicians, more consistent histological confirmation, and closer scrutiny of resected foreskins. The average age at diagnosis clusters around seven to nine years, though cases have been reported across the full pediatric age range, and there is ongoing debate about whether the disease is genuinely rarer in children under five years of age or whether it is simply under-recognized in that younger group, since developmental preputial adhesions are a common and usually benign cause of non-retractility at that age.

The etiology of BXO remains incompletely understood but is generally regarded as multifactorial, involving genetic predisposition, autoimmune mechanisms, and chronic local irritation, with infectious causes proposed but never convincingly substantiated. Histopathological and molecular studies have identified an infiltrate of autoreactive cytotoxic T lymphocytes, altered extracellular matrix metabolism, and dysregulated expression of cytokines and growth factors involved in fibrosis and tissue remodeling, alongside reduced expression of proteins that normally maintain epithelial integrity. Associations have been reported with atopic disease, obesity, and, less consistently, autoimmune conditions such as thyroiditis, vitiligo, and celiac disease, as well as with mechanical trauma from repeated forceful retraction of the foreskin, a phenomenon reminiscent of the Köbner effect seen in other lichenoid dermatoses. A modest proportion of affected boys also have coexisting hypospadias, and phototype has been suggested as a risk modifier, though the evidence here is mixed and sometimes contradictory.

Clinically, the disease typically announces itself as a progressively worsening, secondary phimosis in a foreskin that was previously retractile, often accompanied by ballooning during micturition, dysuria, and, on inspection, a pearly white, sclerotic, circumferential scar at the tip of the prepuce with variable degrees of erythema, fissuring, or telangiectasia. When the glans can be visualized, pallor and thickening of its surface may be evident, and

in a meaningful minority of cases the urethral meatus itself is strictured or discolored. Symptom duration before presentation commonly spans several months, and behavioral changes, constipation, or voiding difficulty may be the presenting complaint in younger children who cannot otherwise articulate genital discomfort. Despite this recognizable clinical picture, the correlation between clinical impression and histological confirmation is strikingly inconsistent across studies, with reported concordance ranging from roughly half to nearly ninety percent, and sensitivity of clinical examination alone often falling below fifty percent even when specificity is high. Combining physical findings with a history of recurrent balanitis, urinary tract infection, or coexisting allergic or autoimmune disease substantially improves specificity and positive predictive value, in some analyses approaching certainty, but only at the cost of markedly reduced sensitivity, meaning that a substantial fraction of true cases could be missed if reliance were placed on history and examination alone. This asymmetry underlies the near-universal recommendation that histological examination of the excised foreskin remains essential for definitive diagnosis, since the absence of supportive history or overt scarring cannot reliably exclude the condition, while conversely, a considerable share of foreskins removed on clinical suspicion of BXO ultimately show only nonspecific chronic inflammation rather than the classic changes of hyperkeratosis, basal epidermal atrophy, homogenized subepidermal collagen with edema, loss of elastic fibers, and a band-like lymphocytic infiltrate.

At the same time, evidence suggests that general practitioners and other primary referrers continue to struggle with distinguishing pathological from physiological phimosis, resulting in a large proportion of circumcision referrals that prove, on specialist assessment, to be unnecessary, alongside a smaller but persistent problem of over-diagnosis by surgeons that risks subjecting some children to circumcision for healthy or merely inflamed, non-BXO foreskins. Both diagnostic inaccuracy and over-caution carry costs, whether measured in unnecessary procedures, delayed appropriate treatment, or the resource burden on health systems, and this tension has motivated calls for clearer commissioning guidance and continued clinician education.

Left untreated or inadequately managed, BXO follows a chronically progressive or relapsing course with scarring, potential contraction of the frenulum, and, in more advanced disease, meatal or urethral stenosis that can produce obstructed flow, acute or chronic urinary retention, and, rarely, retrograde renal damage. Even after treatment, meatal stenosis remains a recognized complication, occurring in a meaningful minority of boys who undergo circumcision, and a smaller proportion require subsequent surgical intervention such as meatotomy, meatoplasty, or, in severe urethral involvement, reconstruction using buccal mucosal grafts. In adulthood, BXO carries a small but non-negligible risk of malignant transformation to squamous cell carcinoma or related lesions, reported in a low single-digit to high single-digit percentage of cases over long latency periods, which underpins recommendations for continued surveillance into adult life.

Circumcision with complete resection of the affected foreskin remains the most widely endorsed definitive treatment, generally curative in the great majority of patients and

associated with a low rate of phimosis recurrence when performed thoroughly. Nevertheless, growing recognition of the psychological and cultural importance many families place on foreskin preservation has spurred interest in alternatives. Topical corticosteroids, most commonly potent formulations such as betamethasone or mometasone applied twice daily for several weeks, have demonstrated genuine, statistically significant symptomatic improvement in randomized and observational studies, particularly in mild to moderate disease, though efficacy diminishes in severe or long-standing cases and long-term recurrence data remain limited. Topical calcineurin inhibitors such as tacrolimus and pimecrolimus offer a steroid-sparing option with a favorable side-effect profile on mucosal skin, generally reserved as second-line therapy or adjuncts after incomplete response to steroids. Surgical alternatives to full circumcision, notably preputioplasty combined with intralesional triamcinolone injection, have shown comparable patient satisfaction and, in feasibility trials, an acceptable safety profile with no observed increase in meatal stenosis, making them an appealing option for families seeking to avoid complete foreskin removal, although uptake remains limited by unfamiliarity among surgeons and the absence of formal endorsement in existing commissioning guidance. Ultimately, the management of BXO in children requires balancing definitive surgical cure against the desire for foreskin preservation, underpinned by vigilant histological confirmation, structured follow-up to detect meatal and urethral complications early, and long-term surveillance given the disease's chronic and potentially premalignant nature.

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E-Bykes

In barely a decade, electric bicycles have gone from a niche market product to one of the fastest-growing modes of transport in the world. Their ability to combine human effort with motorized assistance has made them an attractive tool both for everyday mobility and for physical activity, but this same growth has brought with it a growing body of evidence on specific risks that deserves to be examined together.

One of the pioneering investigations on the subject, carried out through surveys of thousands of e-cyclists in a German-speaking European country, revealed that single-vehicle crashes—that is, falls or loss of control without a collision with another road user—constitute the most frequent type of incident among users of these bicycles. Practically one

in six surveyed cyclists had experienced this type of accident since they began using their electric bicycle. The most common mechanisms included skidding on wet or icy surfaces, falling while crossing curbs or uneven surfaces, getting caught in tram tracks, and evasive maneuvers to avoid obstacles or other road users. Interestingly, the risk of this type of accident did not depend on age, but rather on factors such as being male, high exposure from frequent use, and using the bicycle mainly for commuting to work. However, when the severity of injuries was analyzed, the picture changed: women, older people, and those who perceived themselves as less physically fit had a higher risk of serious injury, a finding that suggests the factors determining the likelihood of an accident are not necessarily the same as those determining its severity.

This distinction between accident risk and severe injury risk repeats itself, with interesting nuances, in a Scandinavian study based on three independent surveys with more than seven thousand participants. There it was found that, overall, electric bicycles showed a slightly higher accident risk than conventional bicycles, but this increase was almost entirely explained by women: among men there was no difference at all between the two types of vehicle. Part of this additional risk in women appeared to be related to unfamiliarity with the vehicle, given that electric bicycles tend to attract a newer cycling public, and prior experience with the bicycle proved to be a robust predictor of accident likelihood. Nevertheless, neither injury severity nor the proportion of accidents requiring medical attention differed significantly between conventional and electric bicycles, leading to the conclusion that the latter are not inherently more dangerous, but rather that their appeal to new users could explain much of the observed risk.

A different picture emerges when examining the Asian context, where electric bicycles are not a recreational add-on but the primary urban transport mode for hundreds of millions of people. An extensive literature review on risky riding behaviors in that setting identified riding patterns markedly different from European ones: illegal occupation of motor vehicle lanes, speeding, running red lights, carrying passengers irregularly, and riding against traffic emerge as the most common infractions and those most associated with crashes. Psychological and demographic factors—age, gender, risk perception, safety attitude, and tolerated waiting time at a traffic light—proved decisive in the likelihood of committing these infractions. This analysis underscores that the electric bicycle phenomenon cannot be understood uniformly on a global scale, since regulation, infrastructure, and road culture in each region substantially shape behaviors and, therefore, risks.

The pediatric population emerges as a group of particular concern in several recent analyses. A study based on a national injury surveillance system in a North American country documented that, while injuries associated with conventional bicycles declined steadily over the decade analyzed, those associated with electric bicycles increased consistently over the same period. Males accounted for the vast majority of these injuries, and the most affected age group corresponded to preteens and adolescents. Beyond frequency, severity proved especially concerning: electric bicycle injuries required hospitalization notably more often than conventional bicycle injuries or even light

combustion-powered motorized vehicles, and showed higher rates of internal injuries and fractures. Added to this is an alarming finding on prevention: in cases where helmet use could be determined, the vast majority of children injured on electric bicycles were not wearing one, a proportion far higher than that observed among conventional cyclists.

Another risk, less discussed but increasingly documented, stems not from riding itself but from the technology powering these vehicles. A review focused on burns associated with personal mobility devices, including electric bicycles, identified thermal runaway in lithium-ion batteries as a recurrent cause of fires and explosions. Hospital cohorts from various Asian cities showed patterns of severe burns, with extensive body surface areas affected and, in some pediatric cases, an injury pattern pointing to a problem of children's accessibility to defective or mishandled batteries. Combustion tends to occur during prolonged or unsupervised charging, and uncertified conversion kits—which transform conventional bicycles into electric ones through DIY methods—represent an additional risk factor repeatedly flagged.

Against this set of risks, there is also a robust body of evidence on the benefits these bicycles bring to public health and the environment, particularly in the context of active commuting to work. A recent review focused on Europe synthesizes how these vehicles allow classic barriers to conventional cycling to be overcome, such as long distances, poor physical fitness, or steep terrain, thereby facilitating the adoption of physical activity among populations that would otherwise remain sedentary. The reviewed studies show improvements in cardiorespiratory capacity after just a few weeks of regular use, metabolic benefits comparable to some extent to those of traditional cycling, and a substantial reduction in carbon dioxide emissions when these vehicles replace trips previously made by car. However, the same review acknowledges that adoption remains low and uneven across the continent, constrained by the high purchase price, lack of charging and secure parking infrastructure, and a social perception that still associates the use of electric assistance with a form of cheating or insufficient effort.

Considering these findings together, a nuanced picture emerges. The electric bicycle is not uniformly more dangerous than the conventional one, but it is not equivalent in every respect either: its higher average speed, additional weight, and capacity to attract inexperienced users—among them women new to cycling and minors—appear to concentrate much of the differential risk observed across studies. The most frequently cited accident mechanisms, such as skidding, loss of balance, and falls when crossing uneven surfaces or rail tracks, are not exclusive to electric propulsion, but the higher speed achieved with less effort could intensify their consequences. Added to this is a distinct technological risk, tied to battery safety, that requires regulatory attention independent of purely road-related aspects.

Taken together, the available evidence suggests that maximizing the benefits of these bicycles—in terms of health, reduced pollution, and urban decongestion—without disproportionately shifting their risks onto the most vulnerable users will require simultaneous progress on several fronts: road infrastructure adapted to higher circulation

speeds, effective policies to promote helmet use, stricter standards for batteries and chargers, and educational strategies specifically targeting new users and minors, without which the accelerated growth of this mode of transport could continue to be accompanied by a parallel increase in the burden of associated injuries.

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