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Return to Sports and Physical Activity After Appendectomy in Children: A Review

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Abstract

Background. Appendectomy is one of the most frequently performed emergency surgical procedures in children, yet recommendations regarding the timing of return to physical activity remain highly variable and are often based on expert opinion rather than robust evidence.

Aim. To review the available evidence on return to physical activity after pediatric appendectomy and propose a practical, criteria-based framework for safe postoperative activity progression.

Material and methods. A review of the literature was conducted, focusing on studies evaluating postoperative activity restrictions, return to sport, abdominal wall healing, and recovery following pediatric appendectomy. Evidence from pediatric and broader abdominal surgery literature was analyzed.

Results. Current pediatric evidence is limited and demonstrates considerable variability in postoperative recommendations. Available studies suggest that, after uncomplicated laparoscopic appendectomy, self-directed return to activity as tolerated does not increase postoperative complications and may accelerate recovery. Prolonged routine activity restriction has not been shown to reduce the risk of fascial dehiscence or incisional hernia. Recovery should instead be individualized according to surgical approach, disease severity, wound healing, pain, functional recovery, and postoperative complications. Emerging wearable-device metrics may provide objective recovery assessment in the future but are not yet suitable for routine clinical decision-making.

Conclusions. Children undergoing uncomplicated laparoscopic appendectomy can generally resume daily activities and gradually return to sports using symptom- and function-based criteria rather than fixed time intervals. More cautious progression is warranted after complicated appendicitis or open surgery. High-quality prospective studies are needed to establish standardized, evidence-based recommendations.

Key words: pediatric appendectomy; return to sport; physical activity; laparoscopy; postoperative recovery.

1. Introduction

Acute appendicitis is a frequent cause of emergency abdominal surgery in children. Modern pediatric care increasingly favors laparoscopic appendectomy, multimodal analgesia, early feeding, early mobilization, and discharge on the day of surgery or within 24 hours for selected children with uncomplicated disease [11-20]. These developments have shortened hospital recovery, but they have not produced equally standardized advice about what happens after discharge. Families commonly receive precise instructions for wound care and warning signs, yet recommendations concerning running, swimming, physical education, playground activity, strength training, and competitive sport may range from immediate activity as tolerated to several weeks of prohibition.

This variability is not merely academic. Children are not smaller adults: their normal lives involve spontaneous bursts of running, climbing, jumping, rough play, school-based physical education, and organized sport. Restriction may lead to missed school, exclusion from peer activities, reduced conditioning, parental work absence, and anxiety about normal movement. Conversely, an overly rapid return in a child with unresolved infection, significant pain, or an incompletely healed open incision may expose the child to avoidable discomfort or complications. The clinical challenge is therefore to distinguish protective caution from unnecessary inactivity.

The available literature supports three broad conclusions. First, direct evidence on return to sport after pediatric appendectomy is sparse. Second, practice patterns are heterogeneous and are not consistently anchored to demonstrated risk [1-6]. Third, recovery depends more on the type of appendicitis, operative approach, complications, symptoms, and functional capacity than on a single postoperative day. The purpose of this narrative review is to synthesize the available evidence and translate it into a practical framework for clinicians, families, physical education teachers, coaches, and young athletes. It is not intended to replace patient-specific instructions from the operating surgical team.

2. Research materials and methods

The evidence base was assembled from peer-reviewed, publicly accessible publications and major evidence syntheses addressing pediatric postoperative activity restrictions, appendectomy technique and outcomes, same-day discharge, enhanced recovery, abdominal wall healing, early mobilization, and return-to-sport decision-making. Priority was given to pediatric studies, systematic reviews, meta-analyses, consensus statements, and clinical guidelines. Adult abdominal-surgery evidence was included only when pediatric data were absent and the biological or mechanical principle was plausibly transferable.

The phrase return to activity is used here as an umbrella term. Return to school concerns cognitive participation and ordinary walking; return to physical activity includes play, cycling, swimming, and physical education; return to training denotes structured sport-specific practice; and return to sport or competition implies unrestricted participation at the previous level. These stages should not be conflated. A child may be ready for school but not for sprinting, and may tolerate non-contact practice before being ready for collision sport.

3. Research results

3.1. Why Postoperative Advice Varies

The strongest direct description of pediatric practice comes from Baumann and colleagues, who surveyed members of the American Pediatric Surgical Association about restrictions after exploratory laparotomy, laparoscopic appendectomy, and inguinal hernia repair [1]. Recommendations after laparoscopic appendectomy varied widely. Many surgeons restricted gym, contact sport, or heavy lifting for two to three weeks, while a substantial minority recommended no restriction for some activities. The authors emphasized the paucity of evidence and the potential social burden of prolonged limitation.

A prospective single-center study subsequently compared physician-directed restrictions with self-directed return after uncomplicated laparoscopic appendectomy or routine inguinal hernia repair [2]. Families in the self-directed group were told to advance activity when the child felt comfortable, whereas the comparison group was restricted from full activity for two weeks. Mean time to full activity was about 9.5 days with self-directed progression and 11.9 days with prescribed restriction; complications and satisfaction did not differ. The sample was modest and not powered to exclude rare adverse events, but it is the most directly relevant prospective evidence and challenges the assumption that every child requires a fixed period of inactivity.

The same pattern appears in adult abdominal surgery. Surveys and systematic reviews document wide variation in recommendations and little high-quality evidence that longer restriction reduces incisional hernia or wound failure [3-6]. Advice is often inherited from tradition, concern about intra-abdominal pressure, or the understandable desire to protect a recent repair. However, coughing, rising from a chair, defecation, and routine daily movements may generate substantial abdominal wall loading, while controlled exercise does not necessarily produce uniquely hazardous strain. This does not prove that all sport is safe immediately after surgery; it does mean that the biological rationale for blanket, prolonged prohibition is weaker than commonly assumed.

3.2. Determinants of Recovery

3.2.1. Uncomplicated versus complicated appendicitis

The most important distinction is disease severity. Uncomplicated appendicitis generally denotes an inflamed appendix without perforation, diffuse contamination, or a mature abscess. Complicated appendicitis includes perforation, gangrene in many classification systems, purulent contamination, phlegmon, or abscess. Definitions vary between studies, but the clinical implications are consistent: complicated disease is associated with greater inflammatory burden, longer antibiotic exposure, higher risk of intra-abdominal collection, ileus, wound problems, readmission, and delayed recovery [11,14].

A child discharged rapidly after an uncomplicated operation and eating, walking, and sleeping normally is not biologically equivalent to a child who had perforation, peritonitis, drainage of an abscess, prolonged fever, or several days of ileus. Return-to-sport advice must reflect that difference. In complicated cases, the limiting factor may be systemic recovery rather than the skin incision. Fatigue, reduced appetite, deconditioning, anemia, persistent bowel disturbance, and fear of movement can all delay safe participation.

3.2.2. Laparoscopic versus open appendectomy

Laparoscopy uses several small port incisions and usually causes less wound morbidity than a larger open incision. Meta-analyses in children and mixed populations generally show advantages in wound infection, length of stay, pain-related recovery, or return to normal activity, although pediatric subgroup findings are not uniform and depend on disease severity and study quality [12-14,29,30]. For complicated pediatric appendicitis, laparoscopic surgery is associated with shorter hospital stay and lower surgical-site infection without a clear increase in intra-abdominal abscess in contemporary analyses [14].

The operative label alone is not sufficient. A nominally laparoscopic procedure may require enlargement of an incision, difficult dissection, extensive irrigation, drain placement, or conversion to open surgery. Port size, fascial closure, and location also differ. Therefore, discharge documentation should identify uncomplicated laparoscopic appendectomy, complicated laparoscopic appendectomy, open appendectomy, or conversion, because these categories imply different expected trajectories.

3.2.3. Pain, medication, nutrition, sleep, and confidence

Pain is both a symptom and a functional limiter. A child who guards the abdomen, cannot stand upright, or requires sedating analgesics should not return to training. However, complete absence of any sensation is not required before walking or normal daily movement. The more useful question is whether discomfort is mild, improving, and non-limiting. Pain that increases from day to day, localizes deeply, or is accompanied by fever, vomiting, distension, or wound change requires reassessment rather than exercise progression.

Adequate hydration, oral intake, bowel function, and sleep are similarly important. Same-day discharge studies show that selected children can recover safely at home after uncomplicated laparoscopic appendectomy when pain and nausea are controlled and discharge criteria are met [15-24]. These studies do not directly establish readiness for sport, but they demonstrate that prolonged bed rest or inpatient observation is not necessary for routine physiological recovery. Enhanced recovery programs reinforce early feeding, non-opioid analgesia, and mobilization as active components of convalescence [19,20,28].

3.2.4. Age, developmental stage, and baseline activity

Age changes both the demands placed on the healing child and the reliability of self-regulation. Preschool children often alternate abruptly between rest and maximal play and may not understand instructions such as avoid strenuous activity. Their readiness is therefore judged mainly from observable behavior: upright walking, spontaneous play, absence of guarding, normal eating and sleep, and the ability of caregivers to prevent climbing, wrestling, trampoline use, or rough play during the earliest phase. School-age children can usually describe pain and follow a staged plan, but social pressure during recess or physical education may exceed what was intended by the discharge instructions. Adolescents may understand restrictions well yet minimize symptoms because of selection trials, competition, identity as an athlete, or concern about losing fitness. The same calendar rule can consequently produce very different actual exposure.

Baseline fitness and body composition also influence interpretation of recovery. A trained adolescent may tolerate walking and cycling early but still be far from the trunk control, acceleration capacity, and fatigue resistance required for competition. Conversely, a previously inactive child does not need to demonstrate an athlete-level test battery before returning to ordinary play. Obesity may increase technical and wound-related risk in some settings, while undernutrition or restrictive eating may compromise energy availability for healing. These factors do not justify automatic prolonged restriction, but they support individualizing progression, monitoring wound status carefully, and comparing the child with his or her own preoperative function rather than with a universal performance standard [8-10,25-27].

3.2.5. The trajectory of fatigue, sleep, and daily function

Recovery after appendectomy is not represented adequately by pain alone. During the first days, sleep disruption, anesthetic effects, reduced energy intake, inflammation, and interruption of normal routine can produce fatigue even when the incisions look satisfactory. A favorable trajectory is characterized by increasing time out of bed, longer comfortable walks, improving appetite, more consolidated sleep, decreasing analgesic use, and renewed interest in school and play. Enhanced recovery pathways deliberately target these domains through early feeding, opioid-sparing analgesia, nausea prevention, mobilization, and family education; contemporary pediatric reviews and appendicitis-specific studies report faster functional recovery without an evident increase in complications when such elements are applied appropriately [19,20,28,31,32]. A plateau or reversal deserves attention. A child who becomes less active, sleeps excessively, develops new night waking from pain, or stops eating after initial improvement should not simply be labelled deconditioned and pushed through exercise.

3.3. Biological Basis: What Is Being Protected?

Parents and clinicians often worry that running or abdominal effort will cause the wound to open or produce an incisional hernia. Healing, however, occurs at several levels. The skin provides an early visible barrier, whereas deeper fascial layers restore mechanical strength through inflammation, fibroblast activity, collagen deposition, remodeling, and increasing cross-linking. Tensile strength is low during the first days and rises gradually over weeks and months; healed tissue does not instantly regain native strength [8-10].

This biological progression justifies avoiding abrupt, maximal, painful loading immediately after an abdominal incision. It does not establish a precise universal day on which sport becomes safe. Fascial failure and incisional hernia are multifactorial, with infection, tissue quality, surgical technique, obesity, malnutrition, and wound complications contributing alongside mechanical load [9]. In a healthy child with small, closed laparoscopic port sites and no infection, the absolute risk associated with ordinary movement is likely low. In contrast, a contaminated open incision or wound infection deserves greater caution.

A 2023 systematic review examining core muscle training immediately after abdominal surgery found no evidence that early core exercise increased fascial dehiscence or incisional hernia, but the evidence was sparse and heterogeneous [7]. This finding should be interpreted as absence of demonstrated harm, not proof that maximal sit-ups, heavy lifting, or collision sport are safe in the first postoperative days. A sensible approach is graded exposure: begin with walking and normal movement, then add low-load trunk control, followed by running, jumping, directional change, and finally contact or heavy resistance.

3.3.1. Skin closure, fascial healing, and port-site mechanics

The visible skin incision is only one component of recovery. Beneath it, the abdominal wall contains fascia and muscle layers that transmit force during coughing, running, landing, and lifting. Laparoscopic ports are smaller than a conventional open incision, but they are not identical: umbilical and larger ports may traverse fascia differently from small lateral ports, and fascial closure practices vary with port diameter, location, age, and surgeon preference. The risk associated with a particular activity therefore cannot be inferred from the number of skin wounds alone. Operative notes and discharge summaries are useful when they document port enlargement, extraction-site extension, drain placement, wound contamination, or conversion to an open incision.

Healing tissue initially relies heavily on sutures and the local extracellular matrix. Collagen synthesis and remodeling then increase load-bearing capacity, while infection and poor tissue quality can weaken the process [8-10]. These principles support avoiding sudden maximal strain early, particularly when an incision was enlarged or contaminated. They do not support the idea that normal walking, coughing, or getting out of bed must be suppressed until the fascia has regained mature strength. In fact, ordinary movement is unavoidable and is incorporated into modern recovery pathways. The practical goal is controlled exposure below the level that provokes pain, guarding, wound change, or systemic deterioration.

3.3.2. Intra-abdominal pressure and the limitations of lifting rules

Restrictions expressed only as a kilogram limit appear precise but are mechanically incomplete. Abdominal wall loading depends on the object, distance from the body, speed of movement, trunk angle, breath-holding, fatigue, and whether the effort is expected or sudden. A light object lifted awkwardly with a Valsalva maneuver may feel more demanding than a heavier object moved close to the body with controlled breathing. Similar pressure changes occur during coughing, sneezing, vomiting, defecation, rising from the floor, and playground activity. The literature reviewed in abdominal surgery has not established a single weight threshold that reliably prevents dehiscence or incisional hernia [3-7].

For children, the more useful early instruction is to avoid maximal or near-maximal effort, breath-holding, painful straining, and tasks that cannot be stopped immediately. Resistance exercise can later be reintroduced by restoring movement quality first, then repetitions and duration, and finally external load. A symptom-free submaximal session does not prove complete tissue maturation, but it provides more information than the label heavy lifting. Any new incisional bulge, increasing focal pain, wound separation, or delayed symptom flare requires cessation and surgical review.

3.4. From Time-Based Restriction to Criteria-Based Clearance

3.4.1. A continuum of return rather than a single clearance date

Return-to-sport medicine increasingly treats recovery as a continuum rather than a binary decision. The Bern consensus described return to participation, return to sport, and return to performance as distinct stages and emphasized shared decision-making, risk tolerance, and functional capacity [25]. Although developed largely for sports injuries, the model is useful after surgery. Calendar time remains relevant because tissue biology evolves with time, but it should be combined with symptoms, examination, surgical details, and sport demands.

3.4.2. Five domains of readiness

For pediatric appendectomy, a criteria-based approach can be organized around five domains: clinical stability, wound status, daily function, movement capacity, and sport-specific tolerance. Clinical stability requires absence of fever, repeated vomiting, worsening abdominal pain, and other signs of infection or ileus. Wounds should be dry, closed, and free of spreading erythema, purulent drainage, separation, or a new bulge. Daily function includes normal walking, stair climbing, sleep, eating, and school attendance without escalating symptoms. Movement capacity includes upright posture, painless cough, trunk rotation, squat, single-leg balance, hop, jog, and acceleration appropriate to age. Sport-specific tolerance requires completion of a graded practice without pain during the session or symptom rebound later that day or the next morning.

3.4.3. A practical functional assessment

A formal laboratory test is not required for most children after uncomplicated appendectomy, but a brief standardized movement screen can make advice clearer. The sequence should begin below sport intensity. First, the child should walk briskly, climb stairs, stand from a chair without using the arms, cough, and take a deep breath without sharp pain or protective flexion. Second, the child can perform several controlled squats, a hip hinge, gentle trunk rotation, and single-leg balance. Third, when appropriate for age, the screen can progress to repeated heel raises, small two-leg hops, an easy jog, gradual acceleration, and controlled stopping. The examiner or caregiver should look for asymmetry, shortened stride, rigid trunk posture, facial distress, holding the abdomen, or refusal that is inconsistent with the child's usual behavior.

For field and court sports, readiness also requires lateral movement and change of direction. A simple sequence may include side steps, a figure-of-eight jog, low-intensity cuts, and several submaximal jumps with quiet landings. For swimming, the wound criterion must be satisfied before immersion; land-based trunk rotation and shoulder movement can be tested first. For gymnastics, combat sports, rowing, and heavy resistance training, the final test should reproduce the characteristic abdominal demand gradually rather than using an unrelated generic drill. Testing should stop with pain, dizziness, nausea, wound pulling that intensifies, abnormal breath-holding, or loss of normal mechanics.

The response after the test is as important as performance during it. Families can use a 24-hour response rule: activity is advanced only when symptoms remain mild or absent during the session, settle promptly afterward, and are not worse that evening or the next morning. A delayed increase in focal abdominal pain, fatigue that disrupts school, renewed analgesic use, or decline in appetite indicates that the dose was excessive or that reassessment is needed. This approach converts return to sport into a series of reversible trials rather than a one-time gamble.

The child's report must be taken seriously, but children may under-report pain to rejoin a team or over-report fear because they believe movement is dangerous. Parents, coaches, and clinicians should watch for guarding, altered running mechanics, hesitation with deceleration, unusual fatigue, and reliance on analgesics. Clearance is strongest when subjective confidence and observable function agree.

3.5. Proposed Staged Return-to-Activity Framework

The following framework is an evidence-informed synthesis for an otherwise healthy child after appendectomy. It is intentionally conservative where direct evidence is absent. The operating surgeon's written instructions supersede this framework. Timing should be extended after complicated appendicitis, open surgery, conversion, wound complications, or delayed recovery.

Table 1. Proposed criteria-based framework for return to physical activity and sport after pediatric appendectomy.

Stage	Typical timing*	Suggested activity	Progression criteria
1. Early recovery	Postoperative days 0-3	Frequent short walks; stairs as tolerated; normal self-care; gentle breathing and posture; no forced bed rest.	Afebrile; drinking and eating; pain controlled with non-sedating medication; no recurrent vomiting; able to walk upright.
2. Daily activity	Approximately days 3-7	School when comfortable; easy walking; light play; gentle stationary cycling; avoid collision, maximal sprinting, and heavy resistance.	Wounds dry and closed; sleep and appetite improving; ordinary walking and stairs do not increase pain.
3. Light training	Approximately days 7-14	Brisk walking, easy cycling, swimming only after wounds are fully sealed and local instructions permit; low-impact drills; body-weight movement at submaximal effort.	Pain-free cough, squat, trunk rotation, jog, and small jumps; no symptom increase later the same day or next morning.
4. Sport-specific progression	Often after about 2 weeks in uncomplicated laparoscopic cases	Progressive running, acceleration, change of direction, non-contact practice, controlled resistance; increase duration before intensity.	Completes a graded session with normal mechanics, confidence, and no pain, wound symptoms, unusual fatigue, or medication requirement.
5. Unrestricted sport	Frequently 2-3 weeks after uncomplicated laparoscopy; often longer after open/complicated surgery	Full practice, contact, competition, heavy resistance, gymnastics, combat sport, or collision exposure.	Surgeon-specific restrictions satisfied; full school and daily function; pain-free sport-specific testing; no clinical red flags.

*Typical timing is not a guarantee of readiness. Children with perforation, abscess, open surgery, conversion, drains, infection, persistent symptoms, or relevant comorbidity require individualized progression.

3.5.1. How to use the staged framework

The stages in the table describe a sequence, not a compulsory schedule. A child may remain in one stage for several days, move forward quickly after a very mild uncomplicated course, or move backward temporarily after an overly demanding session. Progression should usually increase one main variable at a time. For example, an athlete may first lengthen an easy cycling session, then increase cadence, and only later add resistance; a football player may increase running volume before adding cutting and contact. Changing duration, intensity, impact, and contact simultaneously makes it difficult to identify what caused symptoms.

A practical first training exposure is often 30-50% of the child's usual session duration at clearly submaximal intensity. The next session can be increased when movement is normal and there is no later symptom flare. At least one non-contact or modified practice should precede unrestricted contact for sports in which collision, falls, or blows to the abdomen are plausible. Return to competition should follow successful training, not replace it. A child who is physically safe but not yet conditioned for previous performance may return to participation with limits on minutes, repetitions, apparatus difficulty, or contact role.

The framework also separates clearance from performance restoration. An uncomplicated recovery may permit safe participation within weeks, while speed, endurance, coordination, and confidence may take longer to normalize. Coaches should not interpret medical clearance as proof that the athlete can immediately tolerate a full tournament, repeated matches, maximal lifting, or a sudden spike in training volume. Normal load-management principles still apply after the surgical restriction has ended [25-28].

3.6. Practical Application by Activity Type

3.6.1. School, walking, and playground activity

Return to school is usually determined by comfort, stamina, bowel function, and medication needs rather than by incision strength. A child should be able to sit through lessons, walk between rooms, eat and drink, and use the toilet without assistance. A shortened first day may be useful. School staff should receive clear instructions distinguishing classroom attendance from physical education and contact play.

Walking should begin early and increase naturally. It supports confidence, ventilation, bowel motility, and general recovery and is a core element of enhanced recovery pathways [20,28]. Playground activity is more variable than walking: climbing frames, trampolines, wrestling, and unplanned falls can create sudden loading. Young children who cannot reliably self-limit may need closer supervision even when calm play is permitted.

3.6.2. Swimming

Swimming combines wound exposure with trunk and limb activity. The principal early concern is not the stroke itself but immersion before skin closure is secure. Swimming should wait until incisions are completely closed, dry, and free of scab disruption or drainage, and until any adhesive or surgeon-specific instruction permits immersion. Once the wound criterion is met, easy swimming can be a useful low-impact step before sprinting or contact sport. Diving, vigorous starts, and prolonged sessions should be reintroduced later.

3.6.3. Running, football, basketball, and field sports

Running should progress from brisk walking to jogging, then steady running, acceleration, deceleration, and change of direction. Football, basketball, handball, and similar sports add unpredictable contact, twisting, falls, and fatigue. Non-contact technical practice can therefore precede match play. A practical test is whether the child can complete repeated short runs, lateral shuffles, controlled cuts, and small jumps without guarding or delayed pain. Contact should not be the first postoperative training exposure.

3.6.4. Gymnastics, dance, combat sports, and collision sports

Gymnastics and advanced dance place high demands on trunk extension, rotation, impact absorption, and sometimes direct abdominal pressure. Combat and collision sports add blows, throws, grappling, and uncontrolled falls. These activities merit a more conservative final stage even after an uncomplicated laparoscopic operation. The athlete should first demonstrate pain-free bridges or back extension within usual range, controlled landings, rotation, and sport-specific drills. For an open incision or complicated course, explicit surgical clearance is particularly important.

3.6.5. Resistance training and heavy lifting

The phrase heavy lifting is poorly standardized. A school backpack, a toddler sibling, a barbell, and a maximal deadlift are mechanically different. Early resistance should emphasize technique, breathing, and low perceived exertion rather than arbitrary weight thresholds. Exercises can progress from unloaded squat and hinge patterns to light external load, with avoidance of breath-holding, maximal straining, and pain. The systematic literature does not establish that a specific kilogram limit prevents hernia [3-7], so individualized progression is more defensible than a universal number.

3.6.6. Cycling, rowing, and paddling sports

Easy stationary cycling is often useful because intensity can be controlled and impact is low. Outdoor cycling adds balance demands, vibration, traffic risk, and the possibility of a fall; it should therefore follow comfortable indoor cycling and normal reaction time without sedating medication. Rowing and paddling are different: repeated trunk flexion, hip compression, rotation, forceful leg drive, and breath control can load the abdominal wall substantially. These sports should begin with short technique-focused intervals at low resistance before sustained ergometer work, starts, racing, or rough-water conditions.

3.6.7. Racquet, net, and throwing sports

Tennis, badminton, volleyball, and throwing sports combine rotation, reaching, acceleration, and intermittent jumping. Light technical work may be possible before full match play, but serving, overhead smashing, maximal throwing, and repeated defensive lunges should be added gradually. The athlete should demonstrate painless trunk rotation in both directions, controlled deceleration, and repeated low-level jumps before high-velocity serving or throwing. Because competition produces unplanned reactions and fatigue, a symptom-free practice is a more appropriate final bridge than isolated strokes performed while fresh.

3.6.8. Endurance events and multi-session competition

A child may tolerate a short run yet be unready for a long race, tournament, or training camp. Endurance events magnify small deficits in hydration, energy intake, bowel function, sleep, and thermoregulation. Distance should be rebuilt progressively, with attention to unusual heart-rate response, pace deterioration, abdominal discomfort, and recovery later that day. Multi-session competitions should be among the last exposures restored because the second or third bout occurs under fatigue. Recent discharge, ongoing antibiotics, poor appetite, or weight loss argue against using an important event as the first test of unrestricted endurance.

3.7. Special Situations Requiring a Slower Plan

Complicated appendicitis is the clearest reason to slow progression. A child treated for perforation or abscess may appear energetic before systemic recovery is complete. Persistent fatigue, appetite loss, diarrhea related to antibiotics, residual abdominal tenderness, or reduced exercise tolerance should be respected. A return-to-training decision may require follow-up examination, inflammatory markers, or imaging when symptoms raise concern, although routine testing is not necessary in a well child.

Open appendectomy or conversion from laparoscopy usually warrants more conservative loading because of the larger fascial incision and the circumstances that prompted conversion. There is no high-quality pediatric trial defining the optimal restriction period. Many clinicians use approximately four to six weeks before maximal or contact activity after open abdominal surgery, but this should be described as customary conservative practice rather than a proven threshold [1,4-6]. Functional progression can still begin earlier with walking, school, and low-load activity if the wound and clinical course are satisfactory.

Other reasons for individualized clearance include wound infection, dehiscence, a new incisional bulge, intra-abdominal abscess, drain placement, reoperation, prolonged ileus, significant cardiopulmonary disease, immunosuppression, malnutrition, severe obesity, bleeding disorder, or participation in elite sport with high training loads. Adolescents who use supplements, restrictive diets, or rapid weight-cutting practices may also need nutritional counseling during recovery.

3.7.1. Children who cannot reliably self-limit

Toddlers, children with developmental differences, and highly impulsive children may not follow graded instructions even when pain is present. Caregivers may need to modify the environment rather than rely on verbal prohibition: temporarily remove access to trampolines and climbing equipment, arrange quiet supervised play, request exemption from rough recess, and avoid situations in which siblings initiate wrestling. The aim is not bed rest. Frequent walking and normal gentle movement remain desirable, but the margin for unplanned maximal effort is smaller when the child cannot communicate symptoms or stop on request.

3.7.2. Competitive adolescents and pressure to return

Competitive adolescents may face selection deadlines, scholarship concerns, team expectations, or fear of detraining. These pressures can distort symptom reporting. A useful conversation separates medical readiness, training readiness, and performance readiness and includes the parent and coach when appropriate. The athlete should not require analgesics to complete practice, conceal wound symptoms, or use stimulants to overcome fatigue. Modified participation preserves team involvement: tactical meetings, technique without contact, reduced repetitions, or conditioning that does not provoke symptoms can reduce the perceived cost of honest reporting. When the athlete has a history of restrictive eating, rapid weight manipulation, or supplement use, nutritional and medical review may be warranted because recovery depends on adequate energy, protein, hydration, and sleep.

3.8. Red Flags During Recovery

Exercise progression should stop and the surgical team should be contacted when any of the following occur: fever after the expected immediate postoperative period; worsening or new focal abdominal pain; repeated vomiting; increasing abdominal distension; inability to maintain hydration; wound redness that spreads, purulent drainage, separation, or bleeding; a new painful bulge at an incision; fainting, breathing difficulty, or disproportionate weakness; or pain that persists after activity and is worse the following morning. These findings are not ordinary training soreness and should not be managed by simply extending rest without assessment.

Mild pulling, awareness of the port sites, and transient fatigue can occur during normal recovery. The distinguishing pattern is trajectory: benign symptoms generally improve, remain low in intensity, and settle with rest; complications tend to worsen, recur with systemic features, or impair eating and ordinary function. Families should be given a direct contact pathway rather than relying on generic internet advice.

3.8.1. Activity trajectory as a marker of recovery

Parents commonly judge recovery from a mixture of appetite, mood, sleep, pain, and visible activity. These observations are clinically useful because direction of change often matters more than a single measurement. Recent pediatric appendectomy studies have explored consumer wearables as a more objective extension of this idea. In one cohort, step-count trajectories in children who developed complications after complicated appendicitis rose more slowly and deviated from normative recovery several days before the complication was recognized [33]. Machine-learning analyses incorporating activity, heart rate, sleep, and clinical variables also distinguished abnormal recovery days, and a later study found that wearable-derived circadian and ultradian biorhythms could retrospectively predict postoperative complications before formal diagnosis [34,35].

These findings do not mean that a smartwatch can clear a child for sport or replace examination. Devices vary in accuracy, adherence is imperfect, and an energetic child can still have a wound problem. Their broader lesson is that recovery is dynamic. A sustained fall in steps, disrupted sleep, or failure to progress should prompt questions, especially when accompanied by fever, appetite loss, or pain. Conversely, a high step count alone should not override surgeon-imposed restrictions after open or complicated surgery. Future remote monitoring may improve early detection and provide individualized baselines, but present decisions remain clinical.

3.9. Communication and Shared Decision-Making

Discharge advice is most useful when it names activities rather than using vague phrases such as take it easy. A written plan can specify school, walking, cycling, swimming, physical education, non-contact practice, contact practice, competition, and lifting. It should also identify the operation performed and whether the appendicitis was uncomplicated or complicated. This reduces conflicting interpretations between family members, coaches, teachers, and primary care clinicians.

Shared decision-making is appropriate because the acceptable level of uncertainty differs. A recreational swimmer and an elite gymnast face different consequences of both early return and prolonged absence. The child's preferences matter, but they should be balanced with clinical risk and developmental capacity. The final decision should consider the health risk of participation, the risk of prolonged inactivity, the importance of the event, availability of modified practice, and the ability to stop if symptoms appear [25].

Physical activity is fundamental to child health, and global guidelines recommend regular moderate-to-vigorous activity and limiting sedentary behavior [26,27]. A postoperative plan should therefore aim not only to prevent rare complications but also to restore normal movement promptly. The desired outcome is neither immediate unrestricted sport nor reflexive inactivity; it is progressive, confident, symptom-guided re-engagement.

3.9.1. What a useful clearance note should contain

A practical school or sport note should identify the procedure and date, distinguish uncomplicated from complicated appendicitis when known, and state whether the approach was laparoscopic, open, or converted. It should list permitted activities and the next progression step rather than only stating no sports. For example: classroom attendance and walking as tolerated; no physical education or contact play until a specified review; swimming only after wounds are fully closed and immersion is permitted; modified non-contact training when pain-free jogging and jumping are demonstrated; and immediate cessation for fever, worsening abdominal pain, vomiting, wound drainage, or a new bulge. The note should name who can provide final clearance and how the family can contact the surgical team.

3.9.2. Psychological readiness and fear of movement

Some children remain guarded after tissue healing because they interpret every pulling sensation as damage. Others feel physically normal and become frustrated by restrictions. Clear explanation reduces both responses. The child can be told that mild awareness of the incision may occur during recovery, while sharp, increasing, or persistent pain is a reason to stop. Demonstrating safe movements in clinic or at home can rebuild confidence. Progress should be praised for quality rather than speed. If fear persists despite normal examination and repeated symptom-free trials, brief input from a pediatric physiotherapist or psychologist may help, particularly in athletes whose identity and anxiety are closely linked to competition.

Communication should remain consistent across surgeon, pediatrician, school nurse, physical education teacher, physiotherapist, and coach. Conflicting messages such as unrestricted activity from one clinician and six weeks of complete rest from another undermine confidence and adherence. When uncertainty exists, the team should state it explicitly and agree on the next observable criterion. A shared staged plan is usually easier to follow than either unrestricted permission or a vague prohibition.

3.10. Evidence Gaps and Research Priorities

The evidence base has several limitations. The only prospective pediatric study directly addressing activity restriction combined appendectomy with inguinal hernia repair, allowed families to select groups, and was too small to evaluate rare events [2]. Surveys describe practice but cannot determine effectiveness [1,5,6]. Same-day discharge studies establish the safety of early home recovery in selected patients but do not measure sport exposure, training load, or abdominal wall outcomes [15-24]. Adult abdominal-surgery reviews are informative yet cannot fully account for pediatric tissue biology, behavior, and sport patterns [3-7].

Future studies should use standardized definitions of uncomplicated and complicated appendicitis; record laparoscopic port size, fascial closure, conversion, and wound complications; distinguish school, daily activity, training, contact practice, and competition; and measure both early adverse events and longer-term incisional hernia. Wearable activity monitors could objectively quantify steps, intensity, and recovery rather than relying only on family recall. Randomized or pragmatic trials comparing a fixed restriction period with criteria-based self-directed progression are feasible in uncomplicated laparoscopic cases, provided clear rescue instructions and independent safety monitoring are used.

Patient-centered outcomes are also needed. Missed school, caregiver work absence, anxiety, sleep, pain interference, satisfaction, and time to regain previous performance may be as relevant as readmission. Research should identify which children genuinely benefit from extended restriction and which can safely return sooner. Until such evidence exists, transparent communication about uncertainty is more scientifically honest than presenting tradition as established fact.

3.10.1. Measuring recovery in future studies

The next generation of studies should report actual exposure rather than prescribed restriction alone. Two children both told to avoid sport for two weeks may differ greatly in daily steps, playground behavior, lifting, and adherence. Wearable activity and sleep measures, brief patient-reported outcome instruments, training logs, and school attendance can quantify recovery more accurately [33-35]. Outcomes should include wound infection, dehiscence, incisional hernia, abscess, emergency visits, and readmission, but also pain interference, fear, caregiver work absence, time to full school attendance, time to modified training, and time to previous performance.

Trials should be stratified by uncomplicated versus complicated appendicitis and by laparoscopic, converted, and open surgery. Rare adverse events require multicenter sample sizes and longer follow-up than the usual 30-day surgical outcome window. Until those data exist, recommendations should be graded according to evidence source: direct pediatric restriction studies at the top, pediatric appendectomy recovery studies next, and adult abdominal-wall evidence used only for cautious inference. This hierarchy prevents customary practice from being presented as proven fact.

3.11. Clinical Algorithm and Worked Examples

A concise clinical algorithm begins with four questions. First, was the appendicitis uncomplicated or complicated? Second, was the operation fully laparoscopic, converted, or open, and were any incisions enlarged or drains placed? Third, has recovery been steadily favorable, with no fever, vomiting, wound problem, or worsening pain? Fourth, can the child complete age- and sport-appropriate functional tasks without guarding or delayed symptoms? An uncomplicated laparoscopic case with a favorable trajectory can usually follow the staged pathway. Any answer indicating greater disease burden, a larger incision, a complication, or abnormal function moves the child to individualized surgeon-led review.

Example 1: an otherwise healthy 10-year-old after uncomplicated laparoscopic appendectomy. The child is discharged the day after surgery, walks comfortably, eats normally, and uses only non-sedating analgesia. School resumes with exemption from physical education. During the following week, walking and easy cycling increase. Once the wounds are closed and the child can cough, squat, jog, hop, and turn without pain, modified non-contact football practice begins. Duration is increased before sprinting and cutting. Full contact follows a symptom-free graded practice and satisfaction of the surgeon's written restrictions. This example illustrates why ordinary activity can resume before unrestricted competition.

Example 2: a 14-year-old competitive gymnast after perforated appendicitis treated laparoscopically, with several days of antibiotics and persistent fatigue. Small skin incisions do not make this an uncomplicated recovery. The early plan prioritizes nutrition, sleep, school tolerance, and walking. Light conditioning begins only when appetite and energy are improving and there are no signs of abscess or wound infection. Trunk extension, rotation, hanging, impact landings, and advanced apparatus skills are restored sequentially. Explicit surgical review is appropriate before maximal tumbling or competition because systemic recovery and the high abdominal demands of the sport extend beyond skin closure.

Example 3: a 7-year-old after conversion to open appendectomy who feels well and wants to use a trampoline at one week. The favorable symptoms are reassuring, but the larger fascial incision and the unpredictable impact and falls associated with trampolining justify a slower pathway. Walking, school, and calm play can progress, while jumping exposure begins later with controlled low-level hops and only after wound and movement criteria are met. The final return to trampoline activity should follow the surgeon's restrictions. The example shows that a child's enthusiasm is one readiness domain, not the sole determinant.

These examples are illustrative rather than prescriptive. They demonstrate how the same operation name can lead to different plans when disease severity, incision, sport demands, developmental capacity, and recovery trajectory are considered together.

3.11.1. Minimum information for a return-to-sport decision

A defensible decision does not require extensive testing, but it should be based on a minimum dataset. The clinician or family should know the operative approach, whether appendicitis was uncomplicated or complicated, whether an incision was enlarged or converted, and whether the postoperative course included fever, abscess, wound infection, ileus, readmission, or reoperation. Current status should include temperature trend, oral intake, bowel function, analgesic use, sleep, school tolerance, wound appearance, and the direction of pain and activity over several days. Finally, the actual sport exposure must be described: walking is not equivalent to sprinting, a technical swimming session is not equivalent to racing and diving, and non-contact football practice is not equivalent to a full match. Recording these elements makes the reasoning transparent even when the evidence cannot provide a precise day [1,11,25].

For an uncomplicated laparoscopic case with a steady recovery, many decisions can be made from the discharge plan plus a brief symptom and function review. In-person reassessment becomes more valuable when the diagnosis or operation is unclear, symptoms are not improving, the athlete participates in collision or high-load trunk sport, or the requested return would occur earlier than the surgeon's instructions. Examination can verify wound closure, exclude an incisional bulge, assess focal tenderness, and observe movement. Laboratory tests or imaging are not routine clearance tools in an asymptomatic child; they are directed by concern for infection, abscess, obstruction, or another complication. Clearance should never be granted solely to meet an event deadline when the clinical trajectory is abnormal.

3.11.2. Levels of clearance

It is often useful to document one of four levels rather than a simple yes or no. Level 1 permits school, walking, and ordinary self-care. Level 2 adds light aerobic exercise and controlled non-contact skill work. Level 3 permits full-intensity non-contact training and progressive resistance but excludes collision, uncontrolled falls, or maximal straining. Level 4 permits unrestricted practice and competition. Each level should state the conditions for advancement and the red flags that reverse progression. This format allows the child to remain engaged while risk is reduced and makes clear that return to participation can precede return to performance. The level can be revised as new information emerges, consistent with the dynamic return-to-sport model [25].

14. Conclusions

There is no strong evidence that every child requires several weeks of complete activity restriction after appendectomy. For selected children after uncomplicated laparoscopic appendectomy, early walking, rapid return to ordinary daily function, and a self-limited progression toward sport appear reasonable. Direct pediatric evidence suggests that allowing return when comfortable does not increase observed complications, but the available study is small and rare risks remain uncertain [1,2].

A safe plan should integrate time with clinical and functional criteria. The child should be afebrile, eating and drinking, off sedating analgesics, healing normally, and able to perform progressively demanding movements without pain, guarding, or next-day symptom flare. Non-contact training should precede collision or unrestricted competition. Complicated appendicitis, open surgery, conversion, infection, abscess, or delayed recovery require a slower, surgeon-led pathway. The most defensible message is therefore not a universal number of days, but a graded return anchored to the operation performed, the course of disease, wound status, symptoms, function, and sport demands.

Disclosure

Author's contribution

Conceptualization JS and ZO; methodology KK; software MZ; check KW, ND and YL; formal analysis HK; investigation KJ; resources JS; data curation ZO; writing -rough preparation JS; writing -review and editing JS; visualization KK2; supervision ND; project administration JS. All authors have read and agreed with the published version of the manuscript

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Declaration on the Use of Artificial Intelligence

AI-assisted tools were used exclusively for linguistic refinement. The authors take full responsibility for the scientific content, interpretation of the data, and final version of the manuscript

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