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Plastic and Reconstructive Surgery in Sports Medicine: Interdisciplinary Intersections, Clinical Management, and Optimization of Return to Play (RTP) - a narrative review

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Abstract

Background: Modern high-velocity athletics and collision disciplines have increased the incidence of complex trauma and biomechanical dysfunctions. Beyond conventional orthopedic care, plastic and reconstructive surgery plays an essential role: restoring anatomy after injury and optimizing body mechanics for performance.
Aim: To summarize current evidence on plastic, aesthetic, and reconstructive surgery in athletes, emphasizing functional biomechanics, exercise performance, and safe return to play (RTP).
Material and methods: A structured literature search of major databases (PubMed, Scopus, Cochrane Library, Google Scholar; prioritizing 2016–2026) was performed using MeSH terms related to plastic surgery, sports trauma, and athletic performance.
Results: Patient-specific 3D-printed carbon-fiber orthoses for craniomaxillofacial fractures expedite safe and full RTP in rugby players, from 8-12 weeks to 2–3 weeks post-fixation. Early orthoplastic microvascular flap coverage and anatomical tendon re-anchoring (e.g., flexor digitorum profundus avulsion repair within 7–10 days) preserve joint kinematics and lower complication rates. Functionally, reduction mammaplasty provides significant gains in VO2max, running economy, and spinal posture alignment. Subfascial, subpectoral or dual-plane pocket method of breast augmentation are preserving pectoralis major strength, however subfascial approach prevents animation deformities. In bodybuilders with AAS-induced gynecomastia, open intra-areolar adenectomy with liposuction effectively removes dense fibrotic parenchyma, though elevated bleeding risks require strict perioperative care. Functional labiaplasty resolves saddle-induced chafing in 86,2% of female participants.
Conclusions: Plastic surgery provides essential anatomical restoration and functional optimization in sports medicine. Individualized, criterion-based RTP protocols minimize complications and expedite safe clearance.

Key words: facial trauma sports, craniomaxillofacial injuries athletes, reduction mammaplasty, breast reduction exercise tolerance, hand injuries athletes plastic surgery, sagittal band rupture athlete, orthoplastic approach lower extremity trauma, jersey finger, gynecomastia anabolic-androgenic steroids, gynecomastia bodybuilders.

1. Introduction

Modern sports traumatology and athletic performance medicine operate within an increasingly demanding environment. The rising physical intensity, velocity, and force profiles seen in professional team collision sports, extreme downhill disciplines, and combat athletics have precipitated an unprecedented frequency of complex, high-energy injuries [1, 4]. Historically, the clinical trajectory of an injured athlete was managed primarily through an orthopedic and physical therapy paradigm focused predominantly on skeletal stabilization and joint kinematics. However, competitive and recreational athletic activities frequently induce severe soft-tissue disruptions, composite craniomaxillofacial fractures, delicate tendinous avulsions of the hand, and extensive integumentary shear injuries that challenge the boundaries of conventional isolated orthopedic management [1, 20, 25].

Consequently, an interdisciplinary synthesis between sports medicine and plastic and reconstructive surgery has emerged as an essential clinical interface [1, 25]. The reconstructive surgeon contributes specialized microsurgical, tissue-preserving, and aesthetic expertise necessary to manage structural deficits where traditional primary closure or gross immobilization would lead to debilitating functional loss [6, 20]. Unlike the general non-athletic patient - for whom the restoration of baseline activities of daily living defines a successful surgical outcome - the athletic cohort operates under distinct physiological, mechanical, and psychological constraints. That changes the requirements for the athletic patients who need complete anatomical and dynamic restoration to endure maximal eccentric and concentric loads after the procedure; minimal myofascial disruption and minimal secondary donor-site morbidity; mitigation of restrictive hypertrophic scar tissue or adhesions that could impair range of motion and joint proprioception; accelerated, criterion-based return-to-play (RTP) pathways designed to safely attenuate the substantial career and financial ramifications of prolonged competitive absence [1, 4, 9].

Simultaneously, plastic surgery intersects with sports science not merely as a salvage specialty, but as an active modality for biomechanical and functional optimization. Morphological disharmonies, ranging from macromastia causing upper crossed syndrome, altered gait kinematics, and restricted ventilatory mechanics to perineal soft-tissue hypertrophy causing chronic microtrauma in saddle-bearing endurance sports, those issues represent documented physical barriers to athletic participation [8, 10, 14]. Furthermore, lifestyle - and performance-related endocrine sequelae, particularly anabolic-androgenic steroid induced gynecomastia in strength athletes, demand distinct multimodal surgical interventions that differ fundamentally from standard idiopathic presentations [3, 5, 11].

Despite the profound relevance of reconstructive techniques to athletic longevity, the literature addressing this intersection remains fragmented across disparate surgical and sports medicine journals. There is a pressing need for a comprehensive synthesis that delineates the mechanical principles, clinical decision-making algorithms, and tailored postoperative rehabilitation protocols governing the surgical care of athletes. Therefore, this narrative review aims to systematically analyze contemporary clinical evidence (2016–2026) across key subdisciplines linking plastic surgery and sports medicine—including craniomaxillofacial trauma, functional breast and body-contouring surgery, hand and orthoplastic reconstruction, and endocrine-mediated conditions—to establish an integrated framework for clinical management and safe return-to-play optimization.

2. Materials and Methods

This study was conducted as a structured narrative review focusing on the applications of plastic, aesthetic, and reconstructive surgical procedures in competitive and recreational athletes, as well as on their biomechanical implications and safe return-to-play (RTP) optimization. The literature search was conducted in the PubMed database, with supplementary screening of Scopus, Cochrane Library and Google Scholar. The search was iterative and used combinations of terms related to the primary domains of the review, including plastic surgery, reconstructive surgery, sports medicine, athletic trauma, craniomaxillofacial fractures, facial trauma, reduction mammaplasty, breast augmentation, gynecomastia, anabolic-androgenic steroids, hand injuries, Jersey finger, Skier's thumb, orthoplastic approach, labiaplasty, and return to play.

Publications from 2016–2026 were prioritized. Older studies and seminal textbooks were included only when they directly addressed foundational operative techniques, anatomical classifications, or provided essential clinical data that were insufficiently represented in more recent literature (e.g., standard surgical excision principles or classic ligamentous repair techniques). Eligible publications included original clinical trials, prospective and retrospective observational cohort studies, systematic reviews and meta-analyses, consensus statements, and selected narrative reviews directly relevant to athletic cohorts. Studies involving athletes, physically active individuals, and military personnel were prioritized. Publications concerning the general population were included when they provided direct evidence regarding tissue healing, biomechanics, pulmonary function, or surgical outcomes applicable to sports medicine. Publications not directly related to surgical management, non-peer-reviewed conference abstracts, commentary letters, animal models, and sources whose content did not permit reliable assessment of the clinical questions were excluded. The evidence was synthesized qualitatively, with particular emphasis on injury mechanisms, tissue-specific healing timelines, biomechanical outcomes (such as ventilatory capacity, pectoral function, or gait kinematics), and structured rehabilitation criteria. In accordance with the methodology for narrative reviews, no meta-analysis or formal risk-of-bias assessment was performed.

The final qualitative synthesis comprised 25 publications: 18 published between 2016 and 2026, and 7 foundational and clinical publications published prior to 2016, retained due to their direct relevance to surgical anatomy, trauma classification, and core operative techniques addressed in this review.

3. Research results

3.1. Craniomaxillofacial Sports Trauma

Fractures and soft-tissue injuries of the facial skeleton account for a consistent proportion of overall trauma sustained in contact, collision, and team disciplines (soccer, rugby, basketball, combat sports) [4]. Epidemiological studies and athletic trauma registries indicate that isolated nasal bone fractures represent the most prevalent skeletal injury (accounting for 40% to 50% of sports-related facial fractures), followed by zygomaticomaxillary complex (ZMC) fractures, orbital wall fractures (blowout fractures), and mandibular fractures [2,4].

Soft-tissue management requires meticulous adherence to plastic surgical principles. Precise, tissue-sparing debridement that safeguards marginal vascularity, multilayered wound closure to distribute tension to the subcutaneous fascia, and the use of fine monofilament sutures substantially mitigate the risk of hypertrophic scarring and contractures that could impair facial expression or visual fields [12, 25].

In acute auricular hematoma, which is frequently encountered in wrestling and rugby, prompt needle aspiration or incision combined with contoured bolster compression prevents ischemic cartilage necrosis and permanent end-stage fibrocartilaginous deformity ('cauliflower ear') [12].

For non-displaced nasal bone fractures, closed reduction within a 7- to 10-day post-injury window remains the therapeutic standard [2]. In unstable ZMC and orbital fractures, open reduction and internal fixation (ORIF) with low-profile titanium mini- and microplates represents the procedure of choice [2, 4]. A major technological advance in recent years is the integration of 3D scanning and computer-aided additive manufacturing (CAD/CAM): customized carbon-fiber protective facial orthoses effectively redistribute impact forces onto uninjured bony buttresses (frontal and occipital regions), enabling safe return to full competitive play within 18.3 days postoperatively rather than the traditional 8–12 weeks required for complete osseous consolidation [9, 14].

3.2. Biomechanical and Functional Impact of Breast Surgery in Female Athletes

3.2.1. Reduction Mammaplasty as a Functional Procedure

Macromastia in physically active women presents a documented biomechanical, ergonomic, and physiological barrier. Excessive breast mass shifts the body's center of mass anteriorly, imposing continuous strain across the cervical, thoracic, and lumbar spine while promoting compensatory thoracic hyperkyphosis [10, 18].

Kinematic analyses of gait and running mechanics demonstrate that excessive multiplanar breast displacement compromises vertical stride length, alters trunk rotation, and elevates the metabolic cost of locomotion [8, 10, 18]. Prospective clinical trials and spirometric assessments show that surgical breast reduction in athletic females achieves increased aerobic capacity which is shown by statistically significant gains in spirometric parameters, thoracic decompression and improved chest wall mechanics [13]. Also there is a meaningful decrease in Borg Rating of Perceived Exertion (RPE) during standardized exercise testing [8, 10] which may indicate improved running economy. Over 90% of operated patients have reported resolution or profound alleviation of chronic neck, shoulder, and back pain [10, 24].

3.2.2. Breast Augmentation: Functional Implications of Pocket Selection

In female athletes involved in strength training, calisthenics, rowing, or CrossFit, the anatomical plane of implant placement dictates subsequent functional and athletic capacity [12, 13] – subpectoral or dual-plane pocket carries a distinct risk of animation deformity, wherein isometric contraction of the pectoralis major produces visible distortion, flattening, or lateral displacement of the breast implant, alongside potential decrements in horizontal adduction strength [15, 22].

In different approach which would be subfascial pocket placement, it preserves the structural and functional integrity of the pectoralis major muscle entirely, eliminating contraction-induced implant distortion, and facilitating earlier resumption of upper-body resistance training, representing the preferred approach for high-performance athletes [15, 22].

However studies showed that none of the methods is superior or inferior to the other one in terms of keeping the functionality of pectoralis major muscle.

3.3. Gynecomastia in Athletes and Anabolic-Androgenic Steroid (AAS) Use

The illicit use of supraphysiologic dosages of anabolic-androgenic steroids (AAS) in strength training and bodybuilding disrupts endocrine homeostasis. Exogenous testosterone and its

synthetic derivatives undergo extensive peripheral aromatization to oestradiol via the aromatase enzyme, driving glandular and stromal proliferation in male breast tissue [3, 11].

In contrast to pubertal or idiopathic gynecomastia, AAS-induced tissue is characterized by dense, hyalinized fibrosis (fibrotic parenchyma), rendering standalone suction-assisted liposuction ineffective [5, 11].
The established gold standard consists of a multimodal surgical approach such as open surgical adenectomy which is direct surgical excision of the fibrotic glandular core via an inferior periareolar intra-areolar incision (Webster approach), leaving a 5–10 mm subcutaneous tissue buffer beneath the nipple-areolar complex to prevent postoperative saucer or crater deformity [5, 7]. Different procedure could be contouring liposuction (PAL/UAL) of the surrounding peripheral zones with power-assisted or ultrasound-assisted liposuction to feather the margins and restore a masculine, athletic pectoral contour [5, 11].
Athletes using AAS carry an increased risk of intra- and postoperative hematoma and seroma formation due to secondary hypertension, erythrocytosis, and altered platelet aggregation, requiring rigorous intraoperative haemostasis, prolonged surgical drainage, and strict cessation of ergogenic compounds [3,11].

3.4. Hand Surgery and the Ortho-plastic Approach

Management of complex hand trauma and microvascular soft-tissue reconstruction represent integral pillars of modern plastic and reconstructive surgery within sports traumatology [20, 25].

3.4.1. Acute Tendinous and Ligamentous Injuries of the Hand

A common injurie in contact sports such as Jersey finger (FDP avulsion) being a closed avulsion of the flexor digitorum profundus tendon insertion (predominantly affecting the ring finger in contact sports such as rugby and judo), requires anatomic transosseous refixation or suture-anchor repair within 7–10 days post-injury. Delay leads to proximal tendon retraction into the palm, vincula disruption, and permanent flexion deficits [20, 21].

The disruption of the extensor terminal slip at the DIP joint level – so called mallet finger. This injurie involves more than 1/3 of the articular surface or is associated with joint subluxation warrant surgical stabilization (e.g., percutaneous Kirschner wire fixation via the Ishiguro extension block technique) to restore extensor mechanics [20, 21].

Skier's thumb is the common name for a rupture of the ulnar collateral ligament of the thumb MCP joint. The interposition of the adductor pollicis aponeurosis between the ruptured ligament and its insertion site (Stener lesion) precludes spontaneous nonoperative healing, necessitating urgent primary surgical repair to restore critical pinch grip stability [16, 20].

3.4.2. The Orthoplastic Approach in High-Energy Extreme Sports Trauma

High-energy polytrauma resulting from motocross, downhill mountain biking, and alpine skiing frequently produces open, comminuted fractures with severe composite soft-tissue deficits. The orthoplastic paradigm mandates concurrent, synchronized management by an orthopedic traumatologist (skeletal stabilization) and a reconstructive plastic surgeon (definitive soft-tissue coverage with microvascular free flaps, such as the anterolateral thigh [ALT] or latissimus dorsi flap, within 48–72 hours) [6, 17].

This approach provides robust vascularity to dead space, accelerates osteogenesis, drastically lowers the incidence of chronic osteomyelitis, and preserves functional limb salvage in athletic individuals [6, 17].

3.5. Functional Indications for Labiaplasty in Female Athletes

In athletic disciplines that impose repetitive, axial saddle pressure and shear forces across the perineal region (road cycling, triathlon, rowing, equestrian sports), labia minora asymmetry or hypertrophy induces chronic mechanical microtrauma [14, 23].

Female athletes frequently report recurrent mucosal chafing, excoriations, hematomas, and severe exercise-induced pain that alters pelvic alignment and cycling biomechanics [14, 23]. Reconstructive labiaplasty via central wedge resection (preserving the neurovascularly intact native labial edge) or curved de-epithelialization/trimming restores protective anatomical proportions.

Clinical cohort studies document 86,2% symptom resolution and high functional and psychological satisfaction [19, 23]. Standard postoperative protocols mandate strict avoidance of saddle-bearing activities for 6–8 weeks to ensure sound mucosal and tensile wound healing [14, 19].

3.6. Return-to-Play (RTP) Protocol Synthesis

The following table synthesizes evidence-based rehabilitation timelines and sport-specific return-to-play criteria across plastic surgical interventions:

Table 1. Return to Play Protocol Matrix across Plastic and Reconstructive Procedures

Procedure	Indication	Key Risk	Phase I: Early Mobilization	Phase II: Non-Contact Training	Phase III: Full RTP	Sources
Nasal/ZMC reduction	Facial skeletal fracture	Re-displacement from impact	D 10 Jogging, low impact	D 11 Sports-specific training with 3D mask	W 2-3 Unprotected play	[2, 4, 14]

Procedure	Indication	Key Risk	Phase I: Early Mobilization	Phase II: Non-Contact Training	Phase III: Full RTP	Sources
Reduction mammaplasty	Spinal pain, pulmonary restriction	T-junction wound dehiscence	W 2-3 Walking, lower-body ergometer	W 4-6 Light jogging in high-support compression bra	W 6-8 Full running & resistance training	[8, 10, 13]
Subfascial augm.	Hypoplasia, asymmetry, aesthetic	Hematoma, implant rotation, pocket stretch	W 2 Walking, recumbent cycle	W 4-6 Lower-body training, light jogging	W 8-12 Bench press, full contact sports	[15, 22]
AAS gynecomastia	Glandular hypertrophy, mastalgia	Hematoma, subpectoral seroma	D 10-14 Light walking (minimize sweat)	W 3-4 Isolated lower-body machines	W 6-8 Heavy chest press, sparring	[3, 5, 11]
Flexor tendon repair	FDP avulsion	Rupture under tensile load	D 3-5 Passive motion in dorsal splint	Week 6 Splint discontinued, active grip	W 12 Full grip load, climbing, contact	[20, 21]
Functional labiaplasty	Chafing & perineal saddle pain	Wound dehiscence in shear zone, edema	W 2 Seated upper-body exercise	W 4 Light jogging, frictionless drills	W 6-8 Cycling, equestrian return	[14, 19, 23]

4. Discussion

4.1. Key Findings

A key finding emerging from the available evidence is that plastic and reconstructive surgery plays an indispensable, dual role in modern sports medicine, encompassing both acute structural reconstruction and elective biomechanical optimization [1, 25]. In acute sports trauma—ranging from craniomaxillofacial fractures to high-energy open extremity injuries and closed tendinous avulsions of the hand—early intervention grounded in tissue-sparing, plastic surgical principles directly determines long-term functional recovery and competitive viability [2, 6, 20]. The application of modern rigid fixation techniques and custom 3D-printed composite

orthoses enables athletes to bypass prolonged periods of immobilization, substantially shortening return-to-play intervals while safeguarding consolidating skeletal structures [4, 9]. Similarly, the orthoplastic paradigm provides simultaneous skeletal and microvascular soft-tissue stabilization, drastically reducing deep infection rates and preserving limb salvage in extreme sports trauma [6, 17].

Furthermore, the findings highlight that elective and functional plastic surgical procedures exert direct, quantifiable effects on athletic performance and exercise physiology. Symptomatic macromastia creates documented mechanical, postural, and respiratory hindrances; its surgical correction through reduction mammaplasty reliably yields significant improvements in maximal oxygen uptake (VO2max), submaximal ventilatory efficiency, running economy, and chronic axial spine pain [8, 10, 13, 24]. In aesthetic breast augmentation, the choice of anatomical plane carries functional ramifications for female athletes: subfascial placement preserves pectoralis major contractile strength and prevents contraction-induced animation deformity, presenting a clear advantage over subpectoral dissection [15, 22]. In male strength athletes presenting with anabolic-androgenic steroid (AAS)-induced gynecomastia, the dense, fibrous parenchymal architecture necessitates direct open adenectomy rather than standalone liposuction, with rigorous perioperative vigilance required due to AAS-associated hemodynamic and bleeding risks [3, 5, 11]. Finally, functional labiaplasty resolves recurrent friction-induced microtrauma and perineal discomfort in female cycling and endurance athletes, facilitating normal biomechanical seating without symptom recurrence [14, 19, 23].

4.2. Strengths, Limitations, and Directions for Future Research

A strength of this review is its integrative approach, synthesizing clinical evidence across diverse surgical domains—craniomaxillofacial trauma, functional torso and breast procedures, endocrine-mediated conditions, and complex extremity trauma—within a unified athletic framework. In addition, the incorporation of sport-specific biomechanical parameters and structured, stage-specific return-to-play criteria provides clear, practical clinical utility for multidisciplinary sports medicine teams.

However, several limitations must be acknowledged. The available literature is characterized by considerable methodological heterogeneity, including wide variations in sport disciplines, competitive levels (elite versus recreational), surgical techniques, and follow-up durations [4, 21]. Many sports-specific surgical studies are retrospective cohorts or single-center series with relatively small sample sizes, limiting the generalizability of their conclusions [2, 15, 21]. In addition, due to the narrative nature of this review, data synthesis was qualitative rather than quantitative, and no formal assessment of methodological quality or risk of bias was conducted across the included papers. The literature search was also focused predominantly on major biomedical databases (PubMed/MEDLINE), which may have omitted relevant reports indexed elsewhere.

Future studies should implement standardized, prospective multicenter registries tracking competitive athletes following reconstructive and aesthetic procedures [1, 21]. Particular emphasis should be placed on establishing validated, objective functional criteria—utilizing dynamic kinematic tracking, force-plate assessments, and tissue-specific imaging—to validate return-to-sport clearance and evaluate the long-term career impact of reconstructive interventions in elite athletic populations [1, 9].

5. Conclusions

Plastic and reconstructive surgery represents an essential pillar of modern sports medicine, providing critical interventions that extend well beyond cosmetic objectives to encompass acute structural preservation, biomechanical correction, and functional optimization. The implementation of tissue-preserving surgical techniques, anatomical tendon re-anchoring,

microvascular orthoplastic reconstruction, and patient-specific 3D-printed protective devices significantly reduces time lost to competition while mitigating permanent functional deficits following severe athletic trauma.
Concurrently, functional procedures such as reduction mammaplasty, subfascial augmentation, and labiaplasty resolve chronic physical and mechanical restrictions, producing quantifiable gains in cardiopulmonary efficiency, movement ergonomics, and sport-specific performance. In strength athletes presenting with AAS-induced gynecomastia, tailored multimodal surgical excision combined with strict perioperative management is critical to address dense glandular fibrosis and elevated hemorrhagic risks.
Ultimately, successful surgical management of athletic patients requires active, coordinated collaboration among plastic surgeons, orthopedic traumatologists, sports medicine physicians, and rehabilitation specialists. Return-to-play clearance should strictly avoid arbitrary calendar-based milestones, relying instead on individualized, criterion-driven progression protocols that verify anatomical healing, dynamic functional capacity, and sport-specific readiness.

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References

1. Ardern CL, Glasgow P, Schneiders A, Witvrouw E, Clarsen B, Cools A, et al. 2016 Consensus statement on return to sport from the First World Congress in Sports Physical Therapy, Bern. Br J Sports Med. 2016;50(14):853-864. https://doi.org/10.1136/bjsports-2016-096278
2. Audlin J, Tipirneni K, Ryan J. Facial Trauma Patterns Among Young Athletes. Cranimaxillofac Trauma Reconstr. 2021;14(3):218–223. https://doi.org/10.1177/1943387520966424
3. Beniwal M, Singh K, Singh P, Sharma A, Beniwal S. The Burden of Anabolic Androgenic Steroid-Induced Gynecomastia. Indian J Plast Surgery. 2023;56(4):338-343. https://doi.org/10.1055/s-0043-1771293
4. Boffano P, Roccia F, Zavattero E, Dediol E, Uglešić V, Kovačič Ž, et al. European Maxillofacial Trauma (EURMAT): a multicenter and prospective study. J Craniomaxillofac Surg. 2015;43(1):62-70. https://doi.org/10.1016/j.jcms.2014.10.011
5. Bolijanovic S, Axelsson CK, Elberg JJ. Surgical treatment of gynecomastia: liposuction combined with subcutaneous mastectomy. Scand J Surg. 2003;92(2):160-2. https://doi.org/10.1177/145749690309200209
6. Bumbasirevic Matić S, Palibrk T, Glišović Jovanović I, Mitković M, Lesić A. Mangled extremity- Modern concepts in treatment. Injury. 2021;52(12):3555-3560. https://doi.org/10.1016/j.injury.2021.03.028
7. Cohen M, ed. Mastery of Plastic and Reconstructive Surgery. Boston: Little, Brown and Company; 1994. ISBN:0316149993 https://books.google.pl/books?id=UFtsAAAAMAAJ&hl=pl&source=gbs_slider_cls_metadata_9_mylibrary&redir_esc=y
8. Coltman CE, Steele JR, McGhee DE. Does breast size affect how women participate in physical activity? J Sci Med Sport. 2019;22(3):324-329. https://doi.org/10.1016/j.jsams.2018.09.226
9. DiPalma AD, Zia H, Goodwin B, Al-Shehab U, et al. Efficacy of absorbable vs. non-absorbable patient-specific, 3D-printed implants for the treatment of facial bone fractures: a systematic review and meta-analysis. Oral Maxillofac Surg. 2025;13;29(1):30. https://doi.org/10.1007/s10006-024-01327-x
10. Gilmer G, Xu E, Franklin E, Adams N, Rizzone K. The Impact of Breasts and Bras on Physical Activity Amongst Women and Girls: A Systematic Review and Meta-Analysis. Journal od Women's Sports Medicine. 2024;4(1):39-54. https://doi.org/10.53646/cdp9k364
11. Goodrum JM, Nair VS, Crouch AK, Eichner D, Miller GD. Evaluating the Testosterone-to-Luteinizing Hormone Ratio in Male Anti-Doping Serum Samples: Results From a Transdermal Testosterone Administration Trial and Field Collected Samples. Drug Test Anal. 2026;18(1):9-15. https://doi.org/10.1002/dta.3959
12. Greywoode JD, Pribitkin EA Krein H. Management of auricular hematoma and the cauliflower ear. Facial Plast Surg. Clin North Am. 2010;26(6):451-455. https://doi.org/10.1055/s-0030-1267719
13. Guliyeva G, Cheung JY, Avila FR, Huayllani MT, Boczar D, Broer PN, Forte AJ. Effect of Reduction Mammoplasty on Pulmonary Function Tests: A Systematic Review. Ann Plast Surg. 2021;87(6):694-698. https://doi.org/10.1097/SAP.0000000000002834

14. Hada S, Seto H, Kaketa T, Nagayama M, Kawasaki T, et al. Accelerated Return to Play for Professional Rugby Players After Facial Fractures. J Craniofac Surg. 2019;30(4):1121-1124. https://doi.org/10.1097/SCS.0000000000005138
15. Hamori CA, Banwell PE, Alinsod R, eds. Female Cosmetic Genital Surgery. New York: Thieme; 2017. https://doi.org/10.1055/b-0037-144677
16. Jurat D, Wenzel D. Breast Augmentation in Athletic Women: A Retrospective Survey Assessing Pectoral Muscle Function and Implant Aesthetics Post-Augmentation. Aesthetic Plast Surg. 2022;46(3):1075-1081. https://doi.org/10.1007/s00266-021-02692-8
17. Mahajan M, Rhemrev SJ. Rupture of the ulnar collateral ligament of the thumb: a review. Int J Emerg Med. 2013;12;6:31. https://doi.org/10.1186/1865-1380-6-31
18. Mansour AM, Jacobs A, Raj MS, et al Lower Extremity Soft Tissue Reconstruction Review Article. Orthop Clin North Am. 2022;53(3):287-296. https://doi.org/10.1016/j.ocl.2022.03.003
19. McGhee DE, Steele JR. Biomechanics of Breast Support for Active Women. Exerc Sport Sci Rev. 2020;48(3):99-109. https://doi.org/10.1249/JES.0000000000000221
20. Oranges CM, Sisti A, Sisti G. Labia minora reduction techniques: a comprehensive literature review. Aesthet Surg J. 2015;35(4):419-31. https://doi.org/10.1093/asj/sjv023
21. Rosenbaum YA, Awan HM. Acute hand injuries in athletes. Phys Sportsmed. 2017;45(2):151-158. https://doi.org/10.1080/00913847.2017.1306420
22. Ryan L, Doody O. The treatment, outcomes and management of hand, wrist, finger, and thumb injuries in the professional/amateur contact sport athletes: A scoping review. Int J Orthop Trauma Nurs. 2024:54:101108. https://doi.org/10.1016/j.ijotn.2024.101108
23. Sarbak JM, Baker JL Jr. Effects of breast augmentation on pectoralis major muscle function in athletic woman. Aesthet Surg J. 2004;24(3):224-8. https://doi.org/10.1016/j.asj.2004.02.005
24. Sharp G, Tiggemann M, Mattiske J. Psychological Outcomes of Labiaplasty: A Prospective Study. Plast Reconst Surg. 2016;138(6):1202-1209 https://doi.org/10.1097/PRS.0000000000002751
25. Singh KA, Losken A. Additional Benefits of Reduction Mammaplasty: a Systematic Review of the Literature. Plast Reconstr Surg. 2012;129(3):562-570. https://doi.org/10.1097/PRS.0b013e31824129ee
26. Thorne CH, Chung KC, Gosain AK, Gurtner GC, Mehrara BJ, Rubin JP, Spear SL, eds. Grabb and Smith's Plastic Surgery. 8th ed. Philadelphia: Wolters Kluwer; 2020. ISBN:1496388259 https://books.google.de/books?id=4SaWDwAAQBAJ&redir_esc=y&hl=pl