Management of Acute and Chronic Ankle Instability

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Abstract

Acute lateral ankle ligament injuries are common. If left untreated, they can result in chronic instability. Nonsurgical measures, including functional rehabilitation, are the management methods of choice for acute injuries, with surgical intervention reserved for high-demand athletes. Chronic lateral ankle instability is multifactorial. Failed nonsurgical management after appropriate rehabilitation is an indication for surgery. Of the many surgical options available, anatomic repair of the anterior talofibular and calcaneofibular ligaments is recommended when the quality of the ruptured ligaments permits. Anatomic reconstruction with autograft or allograft should be performed when the ruptured ligaments are attenuated. Ankle arthroscopy is an important adjunct to ligamentous repair and should be performed at the time of repair to identify and address intra-articular conditions associated with chronic ankle instability. Tenodesis procedures are not recommended because they may disturb ankle and hindfoot biomechanics.

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Ankle sprain is a common sports-related injury, with lateral sprains accounting for 85% of all such injuries. The demand placed on accident and emergency departments is significant: in the West Midlands, United Kingdom, an incidence rate of 60.9 ankle sprains per 10,000 persons per year is estimated, with 14% of ankle sprains classified as severe.[1] When extrapolated to the overall population in the United Kingdom, this translates to an estimated 302,000 new ankle sprains each year, of which 42,000 are severe. Ankle sprains also have a financial impact on professional sports clubs. For example, in England's Football (ie, soccer) Association, one third of ankle sprains are sustained during training, and two thirds during matches. Ankle sprains collectively resulted in 12,138 days and 2,033 matches being missed in a 2-year period. The reinjury rate for ankle sprains was 9%. Initial ankle sprains resulted in an average of 18 days and three matches missed, while reinjuries resulted in an average of 19 days and four matches missed.[1]

Under-treated ankle sprains can result in muscle weakness as well as chronic pain and instability. The lateral ankle ligament complex consists of the anterior talofibular ligament (ATFL), the calcaneofibular ligament (CFL), and the posterior talofibular ligament (PTFL). The ATFL extends from the anterior-inferior border of the fibula to the neck of the talus. The CFL runs from the tip of the fibula to the lateral tubercle of the calcaneus. The PTFL extends from the digital fossa on the posterior border of the lateral malleolus to the lateral tubercle of the talus.[1]

Table 1

Classification of Acute Lateral Ankle Sprains[3]

Grade	Description
I	The ATFL is stretched and some of the ligament fibers are torn. No frank ligamentous disruption is present. Mild swelling, little or no ecchymosis on the lateral aspect of the ankle, point tenderness on the ATFL, and no or mild restriction of active ROM. Difficulty with full weight bearing is sometimes seen. No laxity on examination.
II	Moderate injury to the lateral ligamentous complex, frequently with a complete tear of the ATFL ± partial tear of the CFL. Restricted ROM with localized swelling, ecchymosis, hemorrhage, and tenderness of the anterolateral aspect of the ankle. Abnormal laxity may be mild or absent. May be indistinguishable from a grade III injury in the acute setting.
III	Complete disruption of the ATFL and the CFL ± capsular tear ± PTFL tear. Diffuse swelling, ecchymosis on the lateral side of the ankle and heel, and tenderness over the anterolateral capsule, ATFL, and CFL.
IIIA*	Decrease in ROM >10°, edema >2 cm, normal stress radiographs
IIIB*	Decrease in ROM >10°, edema >2 cm, and >3 mm difference in distance between the posterior articular surface of the tibia to the nearest point of talus on radiographic comparison of the uninjured and injured ankle

* Modified by Malliaropoulos et al[4]

ATFL = anterior talofibular ligament, CFL = calcaneofibular ligament, PTFL = posterior talofibular ligament, ROM = range of motion

The terms "ankle ligament laxity," "lateral ankle instability," and "chronic ankle instability" are often used interchangeably. Laxity is a physical sign that is objectively detected on examination. Lateral ankle instability is a symptom, that is, the presence of an unstable ankle resulting from lateral ligamentous injury. The patient with such instability may describe a feeling of the ankle "giving way." Chronic ankle instability refers to repetitive episodes of instability resulting in recurrent ankle sprains.[2]

Acute Lateral Ankle Ligament Injury

Lateral ankle sprains most commonly occur following excessive inversion and internal rotation of the hindfoot while the leg is in external rotation. This places maximal strain on the lateral ankle ligaments.[2] The ATFL, the weakest of the three lateral ankle ligaments, is involved in most lateral ankle sprains, while the CFL is involved in 50% to 75% of such injuries, and the PTFL in <10%.[1]

ATFL laxity is often assessed clinically by comparing the amount of anterior displacement of the talus from the ankle mortise on the injured versus the uninjured ankle. This is done with the hindfoot maintained in neutral, performing the anterior drawer test on the uninjured side. With the hindfoot in neutral, the ATFL is the primary restraint to anterior talar displacement. Laxity of the CFL is assessed with the inversion test, which is used to determine the amount of talar tilt present when the hindfoot is inverted while the talocrural joint is maintained in dorsiflexion.[2]

Lateral ankle ligament injuries are graded from I to III based on increasing amounts of ligamentous damage and related morbidity[3] (Table 1). Malliaropoulos et al[4] further subclassified grade III injuries in athletes into IIIA and IIIB, based on anterior drawer test stress radiographs. In grade IIIA injury, the decrease in range of motion (ROM) was >10°, edema >2 cm was present, and stress radiographs were normal. In grade IIIB injury, the decrease in ROM was >10°, edema was >2 cm, and radiographic comparison of uninjured and injured ankles demonstrated a >3 mm difference in the distance between the posterior articular surface of the tibia to the nearest point of the talus.

Assessment of the patient with a lateral ankle sprain should begin with a physical examination based on the guidelines of the Ottawa ankle rules for diagnosing possible ankle fracture.[5] When warranted, standard ankle radiographs are made to rule out fractures and associated pathology. Stress radiographs may be useful in establishing a tear of the lateral ligamentous complex of the ankle (Figure 1). However, given the present lack of clinical usefulness of this information, we do not recommend routine use of stress radiographs.[6]

The three most common methods used to manage grade III acute lateral ankle ligament injury are cast immobilization, functional management, and surgical anatomic repair. Cast immobilization usually entails a brief period (≤3 weeks) in a below-knee walking cast, followed by up to 12 weeks of proprioceptive rehabilitation. Although immobilization may not be advantageous in the high-performance athlete, it may have a limited role in the low-demand patient who is unable to bear weight through the affected limb immediately following a severe acute sprain.

Functional management implies early mobilization with external

Figure 1

A B

Stress radiographs of the ankle in a patient with lateral ankle ligament sprain demonstrating normal alignment **(A)** and talar tilt **(B)**.

Figure 2

A B

A wobble board **(A)** or trampoline **(B)** may be used for proprioception training during functional treatment of the patient with acute lateral ankle ligament injury.

support and a protocol of rest, ice, compression, and elevation. This is followed by a rehabilitation program consisting of ROM exercises, strengthening, proprioception, and activity-specific training. Proprioception training, which is essential for the recovery of balance and postural control, consists of a series of progressive drills on devices such as wobble boards and trampolines (Figure 2). In addition to providing mechanical stability, external supports also provide proprioceptive feedback and thus aid in rehabilitation.[7]

Ardèvol et al[8] conducted a randomized controlled trial comparing cast immobilization with functional management in patients engaged in regular sports activity. Functional management allowed earlier resumption of sports training, with fewer symptoms at 3 and 6 months postinjury. A greater reduction in objective radiographic laxity with functional management was noted. No difference was found in reinjury rates between the two management options. The authors of a meta-analysis (level I) of randomized controlled trials comparing immobilization and functional management for acute lateral ankle ligament injuries found that functional management was associated with a higher percentage of patients returning to sports.[9] In addition, time to return to work was shorter, fewer patients had persistent swelling or increased laxity at intermediate follow-up, and the ROM of functionally treated patients was less limited than in those who were treated with cast immobilization.

Functionally managed patients also have been shown to have a higher rate of satisfaction than do patients treated with cast immobilization.[9] In a systematic review of nine studies on functional management, Kerkhoffs et al[10] concluded that lace-up supports were most effective, that tapes were associated with skin irritation and were no better than semi-rigid supports, and that elastic bandages were the least effective form of management (Figure 3).

A meta-analysis of surgical versus nonsurgical management of acute ankle injuries found that all available trials had methodological flaws.[11] Thus, the authors were unable to demonstrate a clearly superior management option based on the available pooled data. A more recent randomized controlled trial comparing surgical with functional management, however, found statistically significant differences in favor of surgical intervention with regard to pain ($P = 0.047$), giving way ($P = 0.016$), and recurrent sprains ($P = 0.022$) at follow-up.[12] Consecutive patients attending the accident and emergency department were randomized to either nonsurgical or surgical management. There was no difference in the athletic makeup of each group. Objective scores at follow-up were statistically better for patients who received surgery ($P < 0.001$). Despite superior results in surgically managed patients,

Figure 3

A B C

Photographs demonstrating external ankle supports used to manage acute lateral ankle ligament injury. **A,** Taping. **B,** Air-Stirrup Universe semirigid support (Aircast, Summit, NJ). **C,** Swede-O Brace lace-up support (Swede-O Inc, North Branch, MN).

the authors cited cost, risk of surgical complications, and similar results with delayed and acute repair as reasons not to manage all acute injuries surgically. They suggested that surgery be reserved for the high-demand patient.

Chronic Ankle Instability

Persistent pain, recurrent sprains, and repeated instances of the ankle giving way are the hallmarks of chronic ankle instability. This multifactorial condition can be debilitating to athletes and active individuals, and it can hamper activities of daily living in the lower-demand patient. Although deformity (eg, hindfoot varus, first ray plantar flexion, midfoot cavus, generalized laxity) plays a role in the predisposition to lateral ankle sprain, the combination of mechanical and functional insufficiencies resulting from primary ankle sprain are major factors in chronic ankle instability (Table 2).[2]

Assessment of chronic instability includes a careful patient history to assess the presenting complaint, mechanism of injury, level of activity, and disability. Clinical examination findings may be more subtle than in acute injuries, with minimal ecchymosis and swelling limited to the joint line suggestive of an effusion. Ligament laxity is more easily noted in the patient with chronic instability because the limb tends to be less painful.

Magnetic resonance imaging evaluation can be useful, particularly in demonstrating associated causes of ankle pain, such as chondral injury, bone bruising, radiographically occult fractures, sinus tarsi injury, periarticular tendon tears, degeneration, and impingement syndrome. The cardinal signs of ligament injury on magnetic resonance imaging scans are ligament swelling, discontinuity, a lax or wavy ligament, and nonvisualization.[13]

The primary indication for surgery in patients with chronic ankle instability is failure of nonsurgical management. A patient may benefit from a structured program of functional and prophylactic rehabilitation, which may be supplemented with external splinting. The patient with functional instability is more likely to benefit than is the patient with mechanical instability.[14]

Table 2

Factors Contributing to Chronic Ankle Instability[2]

Mechanical
Pathologic laxity
Arthrokinetic restriction
Synovial changes
Degenerative changes
Functional
Impaired proprioception
Impaired neuromuscular control
Impaired postural control
Strength deficits

The many surgical techniques described for the management of chronic lateral ankle instability are all modifications of techniques that fall into two basic categories: anatomic repair and tenodesis stabilization[15-20] (Table 3). The goals of anatomic repair are to restore normal anatomy and joint mechanics and to maintain ankle and subtalar motion. However, such repair is dependent on the condition of the injured ligaments, which may be attenuated. Tenodesis stabilizations employ various configurations of local tendon grafts to restrict motion without repair of the injured ligaments. Ankle and hindfoot biomechanics are altered as a result.[21]

The Broström technique is the foundation of anatomic repair techniques.[15] The original technique involved midsubstance imbrication and suture of the ruptured ligament ends (Figure 4, A). Gould et al[16] augmented the Broström repair with the mobilized lateral portion of the extensor retinaculum, which was attached to the fibula after imbrication of the ATFL and the CFL (Figure 4, B). Karlsson et al[17] found that the ATFL and the CFL were usually elongated and scarred, not disrupted. They recommended shortening the ligaments and reattaching them to the fibula at their anatomic origins through drill holes. The proximal ligament ends were oversewn to the distal ends to reinforce the repair using a Kessler technique (Figure 4, C).

Table 3

Common Surgical Techniques for the Management of Chronic Lateral Ankle Instability

Anatomic repair
Anatomic repair using imbrication of the lateral ankle ligaments[15]
Augmentation of the Broström repair with extensor retinaculum[16]
Tenodesis stabilization
Peroneous brevis graft tenodesis to fibula and talus[18]
Peroneus brevis graft tenodesis to fibula[19]
Split peroneus brevis graft tenodesis to fibula and calcaneus[20]

The first example of nonanatomic tenodesis stabilization was described in 1952 by Watson-Jones,[18] who weaved a peroneus brevis graft through the calcaneus and the talus (Figure 5, A). This was later simplified by Evans,[19] who passed the distally attached peroneus brevis graft through an oblique posterior-superior drill hole in the distal fibula (Figure 5, B). This construct does not replicate the ATFL or the CFL; rather, it lies in a position in between these two ligaments. The Evans method has been used to augment the Broström repair.[22] Chrisman and Snook[20] described a weave intended to more closely approximate the ATFL and the CFL, incorporating a split peroneus brevis tendon graft to maintain some peroneus brevis function (Figure 5, C).

In one study, the Broström repair produced good or excellent functional results in 91% of patients at 26-year follow-up.[23] However, neither clinical nor radiographic assessment was done, and 9 of the original 31 patients who underwent the procedure were not included in the follow-up. Hennrikus et al[24] performed a randomized controlled trial comparing the outcomes of the modified Broström procedure and the Chrisman-Snook procedure. At 2.5-year follow-up, patients who received a modified Broström repair had markedly better Sefton scores and fewer complications than did the patients treated with the Chrisman-Snook repair.

Karlsson et al[17] reported 87% good to excellent results in patients treated with their described anatomic repair. However, the authors concluded that failure of previous repair, increased generalized ligamentous laxity, and longstanding instability ≥10 years were relative contraindications to delayed repair.

In another study, 30 of 34 ankles managed with the Watson-Jones procedure demonstrated good to excel-

Figure 4

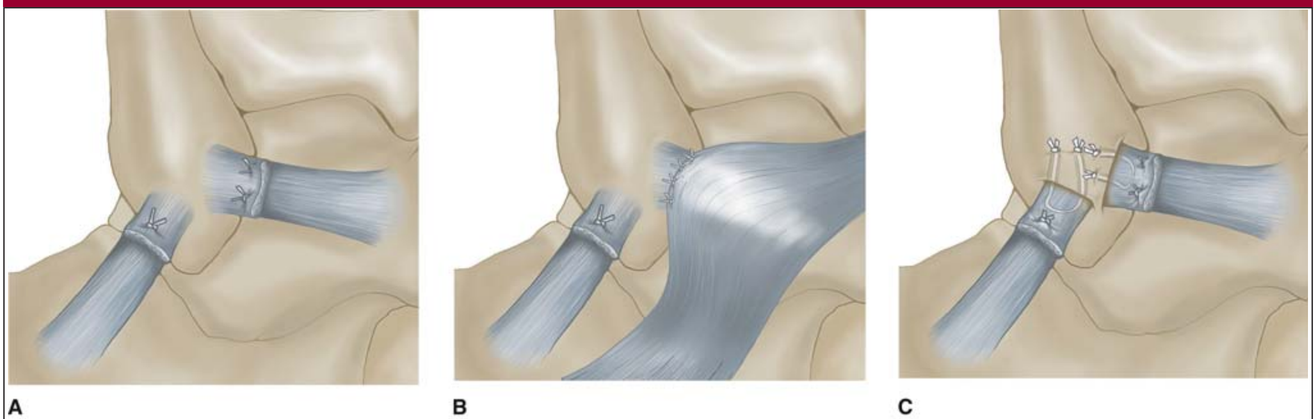
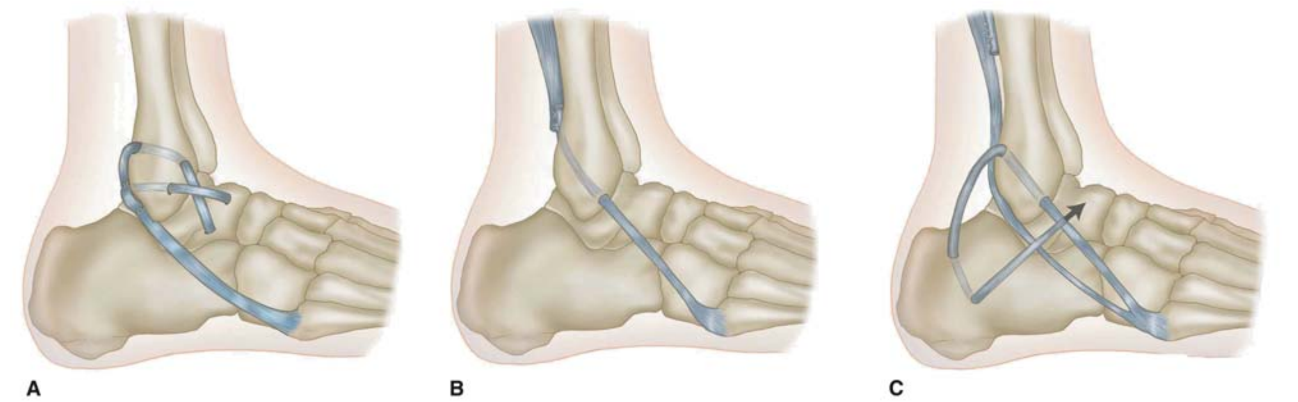


Illustration demonstrating anatomic repair of chronic lateral ankle instability. **A,** Broström anatomic repair, demonstrating midsubstance imbrication and suture of the ruptured ligament ends. **B,** Gould modification augmented with the mobilized lateral portion of the extensor retinaculum. **C,** Karlsson modification, which involves anchoring the proximal ligament ends through drill holes.

Figure 5



Tenodesis reconstruction for chronic lateral ankle instability. **A,** Watson-Jones procedure. **B,** Evans procedure. **C,** Chrisman-Snook procedure.

lent clinical results at 10- to 18-year follow-up.[25] However, 18% of patients experienced complications (eg, instability) and transient or permanent cutaneous nerve injury. No wound complications were noted.

Long-term results with the Evans technique are not favorable. Kaikkonen et al[26] reported that, at an average 4.6-year follow-up, only 52% of patients had returned to preinjury levels. Several patients reported persistent swelling, decreased ROM, and instability. Another study indicated that 50% of patients had unsatisfactory results at a 14-year follow-up.[27] Patients reported either persistent instability or the feeling that the repair was "too tight." In a retrospective long-term (15 to 30 years) comparison of anatomic reconstruction versus Evans tenodesis, patients treated with tenodesis required more revision procedures, particularly for anterior bony impingement, and had more chronic pain, limited movement, instability, and osteoarthritis. The authors reported 80% good to excellent results with anatomic reconstruction, compared with 33% with the Evans tenodesis.[28]

Snook et al[29] reported that 45 of 48 ankles had an excellent or good result at a mean of 10 years following management with the Chrisman-Snook procedure. Fourteen patients had a sural nerve injury (10 transient), and 3 reported recurrence of instability. In a randomized controlled trial, the Chrisman-Snook procedure was associated with significantly more complications compared with a modified Broström repair ($P < 0.001$).[24] Five of 20 patients had wound complications, 11 had sural nerve injury (8 permanent), 6 felt that the repair was too tight, and 2 reported persistent instability. A meta-analysis of seven randomized trials based on the interventions for management of chronic lateral ankle instability was unable to come to a conclusion regarding the best surgical option for management of chronic ankle instability, given the lack of statistical significance and poor methodological quality of the randomized controlled trials available.[30]

Other Types of Repair

Broström[15] found signs of attenuation of the ruptured ligament in 6 of 60 patients with chronic injury. To effectively manage the attenuated tissues, which would make anatomic repair difficult, and to spare the peroneal tendons in order to preserve ankle and subtalar biomechanics, anatomic reconstruction has been developed. Options include periosteal flaps,[31] autogenous grafts (eg, plantaris,[32] gracilis,[33,34] semitendinosus[35,36]), and allograft.[37]

Järvelä et al[31] described the use of periosteal flaps to anatomically reconstruct chronic ruptures of the ATFL and the CFL. In a retrospective review, the authors compared their technique with anatomic repair of acute ruptures and found similar outcomes. However, this study compared patients with chronic instability with those managed for acute ligament injury. Pagenstert et al[32] reported 82% excellent results with anatomic reconstruction using plantaris graft. Another study noted that in 6% of patients, the plantaris was either absent or too weak to function as a graft.[31]

Coughlin et al[33] described a direct repair of the ATFL, which they augmented with a gracilis autograft weaved through drill holes to reconstruct both the ATFL and the CFL. Patient satisfaction was rated as good or excellent in all patients. Boyer and Younger[34] tensioned their gracilis graft with a screw inserted from the lateral aspect of the talus. Paterson et al[35] used a semitendinosus graft to anatomically reconstruct the ATFL alone. Nineteen percent of patients in that study had postoperative instability. Jeys and Harris[36] described using interference screws to anchor a hamstring graft in an anatomic reconstruction.

Although autografts carry an increased risk of donor site morbidity, their mechanical properties are probably better than those of direct repair.[32] Allografts have the advantage of the availability of larger graft, reduced postoperative donor site complications, and avoidance of harvesting tendon with the risk of decreased function. However, there is a risk of infection, subclinical immune response, and increased cost. Caprio et al[37] reported the use of semitendinosus allograft and found a significant ($P < 0.001$) improvement in AOFAS hindfoot scores at 14 months postoperatively. Long-term results of randomized controlled trials of anatomic reconstruction, tenodesis, and anatomic repair are lacking.

The Role of Arthroscopy

Several intra-articular conditions are associated with chronic ankle instability, including osteochondral lesions of the talus, impingement, loose bodies, painful ossicles, adhesions, chondromalacia, and osteophytes. These conditions in themselves may produce ankle pain; left untreated, they may lead to less than favorable results after ligamentous stabilization. Thus, we recommend ankle arthroscopy at the time of surgical repair. Komenda and Ferkel[38] performed arthroscopic assessment at the time of ligamentous repair on 55 ankles with chronic instability. They found that 93% of patients had associated lesions requiring intervention but reported 96% good to excellent results.

Although arthroscopy is an important adjunct to ligamentous repair, its role as a definitive therapeutic method is advancing. In a retrospective review, Maiotti et al[39] used arthroscopic thermal capsular shrinkage without ligamentous repair to treat 22 soccer players with chronic lateral ankle instability. Good to excellent results were reported for 86.3% of patients at 42-month follow-up. More recently, an arthroscopic-assisted, autogenous tendon reconstruction for lateral ankle instability has been described using a three-portal approach.[40] This technique allows both ATFL and CFL reconstruction. However, no results of patients managed with this method have been reported, and the level of arthroscopic expertise necessary to perform this procedure has not been discussed.

Authors' Current Preferred Management

The lack of level I evidence makes it difficult to recommend a particular surgical approach for acute lateral ankle sprain. The authors believe, however, that an anatomic approach should be used whenever possible to manage chronic instability. We perform an arthroscopic assessment of the joint, addressing the various intra-articular lesions, followed by a Broström repair when the quality of the affected ligaments permits. Anatomic reconstruction with ipsilateral free gracilis autograft is used when the affected ligaments are attenuated. Reconstruction using the peroneal tendon should not be done, particularly in high-demand athletes, because this may disturb ankle and hindfoot biomechanics.

Summary

Acute lateral ankle sprain is a common sports-related injury. The evidence suggests that functional rehabilitation should be the treatment of choice for acute injuries, with acute anatomic repair reserved for high-demand athletes. Cast immobilization for a brief period (<3 weeks) may have a limited role in the low-demand individual who is unable to bear weight through the affected limb immediately after a severe acute sprain.

Chronic ankle instability is much less common than acute ankle instability; the former is a multifactorial condition that often results from under-treated acute injuries. The initial management of chronic ankle instability is a robust structured program of functional and prophylactic rehabilitation. Failed rehabilitation is an indication for surgical repair. The results of anatomic repair seem favorable compared with those of nonanatomic tenodesis reconstruction, which is associated with higher rates of sural nerve and wound complications. Long-term studies suggest that the results of the Evans repair deteriorate over time. The role of anatomic reconstruction with autograft and allograft continues to be investigated.

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References

Evidence-based Medicine: Level II prospective, randomized studies include references 5, 7, 9-11, and 23. Level III/IV case-control and cohort studies include references 16, 21, 22, 24-27, 30, 32, 34, and 36-38. The remainder are level V expert opinion or review articles.

Citation numbers printed in **bold type** indicate references published within the past 5 years.

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