Non-specific reviews

1. Lewis KG et al Dermatolog surg **Meta-analysis 2007**	A Meta-analysis of Complications Attributed to Anticoagulation among Patients following Cutaneous Surgery	Meta-analysis	2007 PubMed search (1966–2005) was performed	Six studies representing 1,373 patients	Among patients taking aspirin or warfarin, 1.3 and 5.7% experienced a severe postoperative complication, respectively. Patients taking warfarin were nearly seven times as likely to have a moderate-to-severe complication compared to controls (OR, 6.69; 95% CI, 3.03–14.7), a statistically significant difference (*p*o.001). Patients taking aspirin or NSAIDs were more than twice as likely to have a moderate-to-severe complication compared to controls (OR, 2.0; 95% CI, 0.97–4.13), a strong trend toward statistical significance (*p* = .06). The results of this meta-analysis suggest that while low, the risk of bleeding among anticoagulated patients may be higher than baseline. The results of this meta-analysis suggest that while low, the risk of bleeding among anticoagulated patients may be higher than baseline.	

					Adequately powered prospective studies are required to more carefully delineate the risk of postoperative bleeding and other complications attributable to anticoagulation therapy.	
2. Isted et al 2017 **REVIEW general**	Bleeding on the cutting edge: A systematic review of anticoagulant and antiplatelet continuation in minor cutaneous surgery	SR		To determine the risks of haemorrhagic and thromboembolic complications associated with the continuation or cessation of AC/AP therapy in minor cutaneous surgery	30 studies included data from over 14,000 patients, of which more than 5000 took regular AC/AP therapy. Thromboembolic events were rare but carry high morbidity and even mortality, and in these studies three events were associated with cessation of AC/AP. There was no increase in haemorrhagic complications in patients taking aspirin monotherapy, but evidence is conflicting regarding warfarin and clopidogrel monotherapy, which shows a small increase in rate of bleeding complications. However, no increase in wound dehiscence, graft failure, wound infection or cosmetic outcome was seen. Too few studies investigated DOAC use to draw reliable conclusions	

3. Iyengar S et al dermato surg. 2019	Update and Review of Bleeding Considerations in Dermatologic Surgery: Anticoagulants and Antiplatelets	Review pubmed and medline			Current evidence does not support the discontinuation of antiplatelet and anticoagulant agents in the perioperative period under most circumstances. However, relevant data on novel oral anticoagulant agents are still sparse, suggesting that a precautionary approach is warranted. In terms of dermatological procedures, continued use of these novel oral anticoagulant agents is certainly standard of care. If cessation is necessary, dabigatran may be terminated 24 to 28 hours before the procedure and resumed after hemostasis is achieved. 15 Recommendations on cessation of factor Xa inhibitors before surgery are unknown. Dermatologic surgeons need to be aware of the reversibility of these agents with IV treatments, and the need for hospital	Although the rate of hemorrhage is low (0.11%) in patients on AC therapy undergoing dermatologic surgery, the risk varies depending on the antiplatelet or anticoagulant agent. Discontinuation of warfarin for cutaneous surgery is recommended only if the INR >3.5 Special consideration should be given to patients on multiple agents as they have an increased risk of hemorrhage. If possible, a switch to monotherapy may be implemented

					transfer should patients develop uncontrolled cutaneous or soft tissue bleeding.	
51. Bunick et al. Dermatol ther 2011 **Useful summary of older evidence**	Hemorrhagic complications in dermatologic surgery	Review article			Cook and Perone article – 22/1343 cases, 9 haemorrhagic. Kimyai-Asadi – 1/3937 cases severe haemorrhage - post-operative gastrointestinal haemorrhage Otley et al - The authors calculated an estimated thrombotic risk of one event per ~12,800 operations and suggested that at least one thrombotic event would occur per career in 50% of dermatologic surgeons	These six studies were then analyzed by a meta-analysis performed by Lewis and Dufresne (10). This meta-analysis involved 122 patients taking warfarin, 472 patients on aspirin, and 779 controls undergoing dermatologic surgery for benign and malignant lesions. The study found a sixfold increased risk of moderate to severe bleeding complications in patients taking warfarin compared with controls (12.3% vs. 2.1%, respectively).
56. Henley et al. Dermatology research and practice 2013	Newer Hemostatic Agents Used in the Practice of Dermatologic Surgery	Review article			Distinctly, the combination of Warfarin and Clopidogrel is 40 times more likely to lead to increased perioperative and postoperative bleeding complications, including hematoma formation in comparison to other anticoagulant agents	

Aspirin

4. Bartlett et al Brit journal plastic surgery **ASPIRIN**	Does aspirin affect the outcome of minor cutaneous surgery	Prospective review over 6 months			Age matched cohorts – 52 aspirin, 119 no aspirin. No significant different in minor, significant or total complications in two groups.	
28. Engheta et al. Journal of Pharmaceutical sciences 2016 **ASPIRIN**	Aspirin use and bleeding volume in skin cancer patients undergoing surgery: a randomized controlled trial	RCT		We investigated the occurrence of bleeding complications in patients who underwent skin tumor surgery and compared it between Aspirin users and a placebo control group	In this double blind randomized controlled trial, 32 patients who continued taking aspirin (intervention group) and 38 patients who stopped taking Aspirin (placebo group) before surgery were compared in terms of intraoprative and postoperative bleeding problems, hematoma and local signs of coagulopathy. There was no statistically significant difference in	

					intraoprative bleeding between the study groups (P = 0.107). We concluded that continuation of Aspirin therapy had no significant effect on bleeding complications in patients who underwent skin tumor surgery	

Warfarin

5. Alcalay et al Dermato surg 1999 **WARFARIN**	Cutaneous surgery in patients receiving warfarin therapy	Retrospective			560 patients underwent mohs and 530 excision. Only 16 took warfarin. No issues. INR 2-3.5 is safe	

13. Nelms JK Ann Plast surg 2009 **WARFARIN**	Cutaneous Surgery in Patients on Warfarin Therapy	Retrospective review	To review risks of continuing warfarin in skin surery		26 patients not discontinuing warfarin during cutaneous surgery.	Although our cohort is not sufficiently powered to draw any

					No patient exhibited any major hemorrhagic complications in the intraoperative or postoperative period. Specifically, no subjective difference in bleeding was noticed intraoperatively compared with patients not on warfarin therapy	definitive conclusions, our results suggest that electing not to withhold anticoagulation is safe for superficial soft tissue surgery. A recent review of the literature estimated the risk of thrombosis in patients discontinuing warfarin perioperatively between 1 per 278 and 1 per 1250 procedures
15. Sugden P et al. Surgeon 2008 **WARFARIN**	Continuing warfarin during cutaneous surgery	Prospective study, single surgeon		To determine if it's safe to continue minor cutaneous surgery with normal warfarin dosing	51 patients – two with bleeding complications.	Stated risk of TE was 0.3% discontinuing warfarin if background of AF and up to 6% for DVT.

Aspirin and Warfarin

6. JOSEPH ALCALAY, MD,n AND RONEN ALKALAY, MDw	Controversies in Perioperative Management of Blood	Review and retrospective	2004		A total of 15 articles were published in the literature	

Warfarin and Aspirin	Thinners in Dermatologic Surgery: Continue or Discontinue?				until October 2003. One article showed an increase in complications in patients treated with warfarin, but not with aspirin. All other articles showed no increase in complications during the perioperative period. Data from our practice showed that of a total of 2790 patients, 68 were operated on while taking warfarin (2.4%). Intraoperative bleeding was easily controlled and postoperative bleeding was not recorded in any of the patients	
7. T Otley Warfarin and aspirin	Continuation of medically necessary aspirin and warfarin during cutaneous surgery	Review	2003		Risk of severe haemorrhagic complications not increased.	
8. Kargi et al 2002 aesthetic plastic surgery Aspirin and Warfarin		Prospective study	2002	102 patients, aspirin, warfarin, and that of the patients with no anticoagulant medication were 37, 21, and 44	Of patients taking warfarin, 57% had some complication, significantly more than complications in the control group. The number of major complications in the warfarin group was significantly higher	

					than those of the control and aspirin groups (p = 0.02). Also, the total number of complications in the warfarin group was significantly higher than the control group, but there was no significant difference between aspirin and control groups (p>0.05).	
26. Dixon AJ et al. British journal of Surgery 2007.	Bleeding complications in skin cancer surgery are associated with warfarin but not aspirin therapy	Retrospective review		5950 skin lesions excised in 2394 patients. No patient stopped taking aspirin or warfarin unless the international normalized ratio (INR) exceeded 3·0.	The rate of postoperative bleeding was 0·7 per cent overall and 2·5 per cent in the 320 patients taking warfarin. The rate of bleeding was 1·0 per cent for skin flap repairs, 0·4 per cent for simple excision and closure, and 5·0 per cent for skin grafts. Diabetic patients and smokers were not at increased risk of bleeding. There were four independent factors for bleeding: age **67 years or older** (odds ratio (OR) 4·7 (95 per cent confidence interval 1·8 to 12·2); *P* = 0·002), **warfarin therapy** (OR 2·9 (1·4 to 6·3);	

					P = 0·006), surgery on or around the **ear** (OR 2·6 (1·2 to 5·7); *P* = 0·012) and closure with a skin **flap or graft** (OR 2·7 (1·4 to 5·3); *P* = 0·004). Aspirin therapy was not an independent risk factor for bleeding.	
Kovich et al JAAD 2003 2003;48: 233-7. **Thrombotic risk**	Thrombotic complications related to discontinuation of warfarin and aspirin therapy perioperatively for cutaneous operation.	Our aim was to present a large case series of thrombotic complications resulting from this practice and to estimate the incidence of these events Survey			A total of 168 responding physicians reported 46 patients who experienced thrombotic events. Of these patients, 54% (25 of 46) experienced the event when warfarin was withheld and 39% (18 of 46) when aspirin use was discontinued. Thrombotic events included 24 strokes, 3 cerebral emboli, 5 myocardial infarctions, 8 transient ischemic attacks, 3 deep venous thromboses, 2 pulmonary emboli, and 1 retinal artery occlusion leading to blindness. Three deaths were reported. Calculation of incidence yielded an	

					estimated thrombotic risk of 1 event per 12,816 operations, 1 in 6219 operations when use of warfarin was discontinued and 1 in 21,448 when aspirin was withheld.	

Clopidogrel

Cook-Norris et al JAAD 2011 **Clopidogrel**	Complications of cutaneous surgery in patients taking clopidogrel-containing anticoagulation	Retrospective review 04 - 08		to determine frequency and severity of perioperative complications in patients taking clopidogrel-containing anticoagulation	220 patients taking clopidogrel-containing anticoagulation underwent 363 surgical procedures on 268 occasions	Severe complications occurred in 11 of 363 surgical sites in 10 cases. **Clopidogrel-containing (not monotherapy)** anticoagulation was 28 times more likely than no anticoagulation and 6 times more likely than aspirin monotherapy to result in severe complications after Mohs procedures (P\.001 and P = .022, respectively). Severe complications were

						8 times more likely after Mohs procedures in patients taking both clopidogrel and aspirin than in control subjects taking aspirin monotherapy (P = .009).
Bordeaux et al 2011	Prospective evaluation of dermatologic surgery complications including patients on multiple antiplatelet and anticoagulant medications. *J Am Acad Dermatol* 2011;**65**:576–83.	Prospective review all			Bordeaux et al (2011) reported an odds ratio of 6.55 (95% CI 1.83–23.4; p = 0.004) for bleeding complications following MMS and cutaneous excisions with clopidogrel versus no AC/AP agents.	
Eichhorn et al 2014	Eichhorn W, Haase M, Kluwe L, et al. Increased postoperative bleeding risk among patients with local flap surgery under continued clopidogrel therapy. *Biomed Res Int* 2015;**2015**: 120903.				Eichhorn et al (2014) demonstrated an increased rate of bleeding complications among patients on clopidogrel compared with controls (4.9% versus 1.7%; p = 0.046)	Eichhorn et al (2014) demonstrated an increased rate of bleeding complications among patients on clopidogrel compared with controls (4.9% versus 1.7%; p = 0.046)
Kramer et al Am Surg 2010	Kramer E, Hadad E, Westreich M,					

	Shalom A. Lack of complications in skin surgery of patients receiving clopidogrel as compared with patients taking aspirin, warfarin, and controls. *Am Surg* 2010;**76**:11–4.					

Mulitple agents:

Shimizu I et al JAAD 2008 **Multiple agents**	Multiple antithrombotic agents increase the risk of postoperative hemorrhage in dermatologic surgery J Am Acad Dermatol 2008;58:810-6	retrospective chart review of patients treated in one academic Mohs micrographic surgery department during 1 year		evaluate postoperative bleeding complications in patients who underwent Mohs micrographic surgery while using multiple agents perioperatively compared with patients using a single agent or none at all.	documented the tendency for increased bleeding in patients taking clopidogrelcontaining anticoagulation Patients who took two or more antithrombotic agents (58 patients) at the time of surgery were more likely to bleed than those who took no or only one antithrombotic agent (702 patients)	retrospective review of 760 patients taking antithrombotic agents at the time of Mohs micrographic surgery identified 4 patients who experienced severe postoperative bleeding complications. Three of these 4 patients were on a clopidogrel-containing

					The median patient age was 73 years. Of patients, 62.5% were taking no antithrombotic agents at the time of surgery; 29.9% were taking one antithrombotic agent, and 7.6% two or more antithrombotic agents. The most commonly used antithrombotic agent was aspirin, in 28% of patients. When more than one antithrombotic agent was taken at the time of surgery, the most commonly used combination regimen was aspirin and warfarin (3.2%).	anticoagulation regimen Four patients (0.53%) experienced significant postoperative bleeding complications (Table II). Three of these patients took two or more antithrombotic agents at the time of surgery, whereas one patient was taking no antithrombotic agents

nOACS

9. Eilers et al. Dermol surg 2017	A Retrospective Assessment of	Retrospective review		To determine the incidence of postoperative	Note only 26 haemorrhagic complications.	Postoperative haemorrhagic

NOACS	Postoperative Bleeding Complications in Anticoagulated Patients Following Mohs Micrographic Surgery	A single-center retrospective chart review was performed for all patients treated with oral anticoagulants who underwent MMS between July 1, 2012 and June 30, 2015 at University of California, San Diego		complications in patients undergoing MMS on both traditional oral anticoagulants and new novel oral anticoagulants	July 1, 2012 and June 30, 2015, 1800 MMS procedures were performed at the UCSD Dermatologic and Mohs Surgery Unit on patients taking any form of oral anticoagulant. Overall, 26 (1.4%) cases were found to have reported hemorrhagic complications (Table 1).	complications were 7 times more likely to occur in patients taking any nOAC as compared with all other anticoagulation types combined Specifically, nOACalone as compared with aspirin alone had 6.7 times the odds of being associated with hemorrhagic complications (p = .004) and nOACcombined with aspirin had 10 times the odds of having a hemorrhagic complication compared with aspirin alone (p = .034).
Siscos SM et al. JAAD 2020 **GOOD paper** **DOACS**	Thrombotic complications with interruption of direct oral anticoagulants in dermatologic surgery	Retrospective Study	To assess the 30-day postoperative rate of thrombotic complications (ischemic stroke, transient ischemic attack [TIA], systemic embolism, deep vein		806 procedures – DOAC interruption, 1 case of TIA 0.14% on apixaban. 2 bleeding complications.	

			thrombosis [DVT] and pulmonary embolism) in patients with nonvalvular atrial fibrillation (AF) or a history of DVT who underwent perioperative DOAC interruption during dermatologic surgery			
19. Heard et al. Dermatol surg. 2017 **DOACS**	Complications With New Oral Anticoagulants Dabigatran and Rivaroxaban in Cutaneous Surgery	Retrospective review 2012 – 2015.	918 Mohs cases – of which 15 patients on rivaroxaban – 18 procedures.		Three hematomas were witnessed during this period and all developed in patients on rivaroxaban Somewhat predictably, the hematomas occurred on the neck in 1 case and in the setting of large random flaps in the other 2 cases. The hematomas were uncomplicated, but bleeding could only be controlled with the cessation of the rivaroxaban for 4 days	Patients are counseled in preoperative planning that the closures will be carefully planned to minimize the risk of bleeding, wide undermining will be avoided whenever possible, simple repairs with second-intention healing will be completed if appropriate, and flap closures will be avoided unless a compelling reason exists to use this closure. We await the day that an

					postoperatively in 2 of the cases	antidote to Factor Xa inhibitors will translate to clinical usefulness during Mohs surgery
Chang et al. Dermatol surg 2015. **DOACS**	Complications With New Oral Anticoagulants Dabigatran and Rivaroxaban in Cutaneous Surgery	. Retrospective chart analysis 2010 - 2013		The authors sought to study perioperative complications associated with dabigatran and rivaroxaban during cutaneous surgery	Twenty-seven patients taking dabigatran underwent 41 cutaneous surgeries, with only 1 mild bleeding complication observed that was remedied with a pressure dressing. Four patients on rivaroxaban underwent 5 cutaneous surgeries without complication.	
Gajebasia et al. JAAD. 2021 **INTERESTING** **DOACS**	Preoperative management of blood thinning agents during cutaneous surgery: The need for an individualized approach	Opinion article			The CHA(2)DS(2)-VASc (congestive heart failure, hypertension, age, diabetes mellitus, previous stroke/transient ischemic attack, vascular disease and sex category) score predicts	dermatologist cannot assume what is an acceptable risk to a patient nor presume to tell a patient to stopmedications without a risk-to-benefit discussion; quantifying the risks may

					the risk of stroke,2 and this patient scores 3 (sex, age, and diabetes mellitus), which equates to a risk of 37 per 1000 people in 1 year having a stroke if not anticoagulated	help. In the United Kingdom, the Montgomery judgement conveys this concept and is a legal principle in informed consent.4 It ruled that doctors have ‘‘a duty to take reasonable care to ensure that the patient is aware of any material risks involved Nuanced strategies may be considered, such as swapping clopidogrel for aspirin because it is associated with less bleeding, performing surgery at the DOAC trough level, stopping 1 of 2 bloodthinning medications, or adjusting the medication so that it has reduced but not zero efficacy
Taylor et al. JAAD 2021. **DOACS**	Postoperative bleeding complications associated with blood thinning	A Retrospective Cohort Study			Briefly, 48.9%(1335/2732) of patients on an anticoagulant.	In the 114 patients on a single agent of either a direct thrombin inhibitor or a Factor Xa

	agents during Mohs				Only 28(1.0%) patients experienced a bleeding event following MMS	inhibitor, only one(0.9%) bleeding event occurred.
32. Antia et al. 2017 JAAD **DOACS**	Perioperative complications with new oral anticoagulants dabigatran, apixaban, and rivaroxaban in Mohs micrographic surgery: A retrospective study	Retrospective chart review	A retrospective chart review was performed of all patients who underwent MMS at the University of Cincinnati between October 1, 2011, and September 15, 2016, while they were taking any of the NOACs dabigatran, apixaban, or rivaroxaban		Fifty-one patients who were taking dabigatran, apixaban, or rivaroxaban underwent 76 MMS procedures. The overall rate of complications (Table II) in patients taking NOACs was very low at 3.94% Haemorrhagic complication rate - 1.3% (1 of 76). The patient experienced mild intermittent bleeding for 10 hours after surgery that was controlled with application of direct pressure for 20 minutes. The bleeding complication rate was 1.3% for patients receiving NOACs versus	

					0.7% for all other patients

Other:

12. Kirkorian AY et al Dermatol surg 2007 **SURVEY US**	Perioperative Management of Anticoagulant Therapy during Cutaneous Surgery: 2005 Survey of Mohs Surgeons	Survey report	The goal of our study is to describe the current state of perioperative management of anticoagulant and antiplatelet therapy in Mohs surgery		271 responses, RR 38% In most patients, Mohs surgeons should continue medically necessary anticoagulant and antiplatelet therapy perioperatively. This conclusion is supported by this survey and the literature. Exceptions will occur and all decisions are ultimately up to the discretion of the operating physicians.	The complications reported include 39 strokes, 19 myocardial infarctions, 17 cases of unstable angina, 25 transient ischemic attacks, 7 deep venous thromboses, 4 pulmonary emboli, and 15 deaths

37. Arguello-Guerra et al Cir Cir 2018	Incidence of complications in dermatological surgery of melanoma and NMSC	Retrospective	To report safety of surgery not stopping antithrombotics.		655 patients, 27.7% on aspirin and 4.3% antithrombotic. No increase in haemorrhagic complications observed.	
55. Cohen et al. Dermatol surg 2007 **CASE REPORT**	Intraoral Hematoma: A Novel Complication of Dermatologic Surgery	Case report			Case of intraoral haematoma after right cheek m-plasty on 75mg aspirin,	Although most studies support continuation of anticoagulant medications perioperatively, a 2005 survey of 271Mohs surgeons found that 37% still discontinued medically necessary aspirin and 44% still discontinued Warfarin
59. Chen et al. Dermatol surg 2017	Randomized controlled pilot study of the preoperative use of brimonidine 0.33% topical gel for hemostasis in Mohs micrographic surgery	Assess the hemostatic effect of topically applied brimonidine in patients being treated with anticoagulants and undergoing Mohs micrographic surgery (MMS).		Subjects undergoing MMS were randomly assigned to the control (n = 10) or study arm (n = 14).	The treatment arm had 68% less blood loss over 30 seconds versus the control arm (P\.05). No patient in the brimonidine arm had more than 50% of the wound bed cauterized versus 80% in the controls	