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Outcomes of dermoscope-guided surgical procedures in primary care: case-control study

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ABSTRACT

INTRODUCTION: No research has been found regarding outcomes of dermoscope-guided surgical procedures in primary care.

AIM: To establish whether outcomes of dermoscope-guided procedures performed in primary care settings differ from outcomes for similar procedures, performed without the use of a dermoscope.

METHODS: A retrospective case-control study design was used. All records of dermoscope-guided procedures performed over a 6-month period were retrieved. For each study procedure, the record of the most recent control procedure without dermoscopy guidance performed on a sex-and-age matched patient was retrieved from before we began performing dermoscope-guided procedures. Primary outcomes were: local inflammation and infections within 2 weeks' post procedure; relapse in 6 months; and obvious scars in 6 months. Pain affecting activities of daily living in the first week after the procedure was the secondary outcome.

RESULTS: Records of 39 dermoscope-guided procedures and 39 control procedures were retrieved. No significant difference in local inflammation and infections in 2 weeks was found; relapse in 6 months after the study procedures was significantly lower for dermoscope-guided than control procedures (risk ratio (RR): 0.22; 95% confidence interval (CI): 0.05–0.95), and there were fewer obvious scars for dermoscope-guided procedures than control procedures (RR: 0.52; 95% CI: 0.32–0.83), with the number of small lesions (<4 mm) leaving scars in study procedures particularly less than that for control procedures (RR: 0.30; 95% CI: 0.13–0.67). There was no difference in the secondary outcome of pain affecting activities of daily living in the first week following the procedure.

CONCLUSION: In primary care, dermoscope-guided procedures achieved better outcomes than similar procedures without dermoscope guidance. Performing dermoscope-guided procedures in primary care might lower medical costs.

KEYWORDS: Dermoscopy; general practice; laser procedures; primary health care; skin biopsy; skin microscopy

Introduction

Dermoscopes are instruments used to examine the skin clearly by magnification and epiluminescence – ablating reflections from the skin surface to allow deeper structures to be visualised. They are widely used to diagnose skin cancers and other skin diseases. Dermoscope-guided surgical procedures are relatively new. We have previously reported dermoscope-guided (DG) excisional biopsy,[1] DG punch biopsy[2] and DG suturing.[3] We aimed to find out if outcomes of DG procedures performed in primary care differ from outcomes for similar procedures, performed without the use of a dermoscope. We report here a case-control study comparing local inflammation, infections and pain after DG surgical procedures and after usual surgical procedures.

WHAT GAP THIS FILLS

What is already known: Dermoscope-guided surgical procedures have been reported previously in specialist settings. The outcomes of these procedures performed in primary care settings have not been investigated.

What this study adds: Dermoscope guidance in 39 procedures achieved significantly less relapse and less obvious scars than 39 control procedures without dermoscope guidance performed on age-and-sex matched controls.

Methods

Setup of the procedures

The setting is a solo general practice where the general practitioner (GP) has a special interest in dermatology (AC). Patients can attend our care without referrals. The practice is affiliated with a university teaching hospital.

The room required for DG surgical procedures is the same as for minor operations. One properly trained clinician and one or two trained assistants is all that is required. They must be able to approach both sides of the patient lying on the couch. For practices with only one consultation room, DG surgical procedures can be performed if these requirements are met.

Hand-held dermoscopes are inadequate for DG surgical procedures. The middle and right models with cross-polarisation in Figure 1 are suitable. We secure the dermoscope by clamping it to a sturdy steel stand, so that the receiver is vertically above but not touching the surgical field (Fig. 2), so that the dermoscope does not get into the way of scalpels, laser tips and other surgical equipment. We then connect the dermoscope to a computer outputting signals to a monitor. The depth of the tissue inspected is adjusted by the extent of polarisation. The magnification is governed by the distance between the dermoscope receiver and the surgical field – longer distances result in lower magnifications.

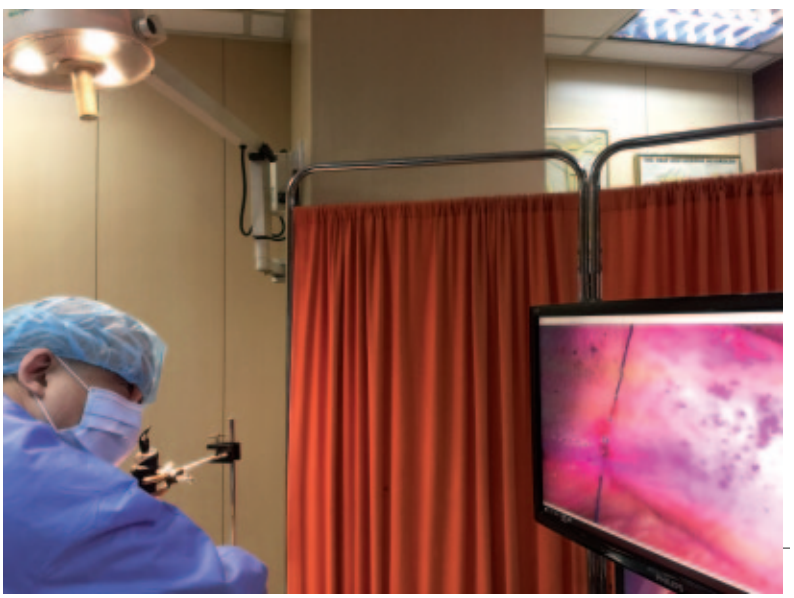
After administration of perilesional anaesthetic agent, we fix our eyes mainly on the monitor during the procedures. The heads of surgical instruments such as forceps can be visualised even after insertion into the surgical field, and can no longer be visualised by the naked eye. Suturing from inside the mucosal surfaces is also possible (Fig. 3). The risk of infection transmission should be considered. In this case study, we placed a microscope slide between the dermoscope and the skin in examinations.[4,5] During

Figure 1. Small hand-held dermoscopes are not adequate for dermoscope-guided surgical procedures. This figure shows the dermoscopes used by us. The left-sided dermoscopy is in the shape of a camera-lens to be mounted on a single-lens reflect camera. This is adequate for assessments and documentations before and after the procedures. The middle (wireless) and right dermoscopes (with wires) are suitable during dermoscope-guided surgical procedures.

dermoscope-guided surgical procedures (DGSP), the head of the dermoscope was not in contact with any tissue.

Figure 2. Set-up for a dermoscope-guided surgical procedure. The dermoscope was placed with the head down above but not touching the lesion (green oval). Surgical instruments and tips of laser units can access the surgical field. The clinician was adjusting the magnification and the extent of polarisation.

Figure 3. The clinician was suturing on the mucosal surface of the wound under dermoscope guidance, therefore, diminishing the chance of damaging important adjacent tissues.



Case-control study

When we started performing DG surgical procedures, we had no academic intention. We published three case reports subsequently[1–3] and then decided to scientifically investigate patient outcomes from DR surgical procedures. We searched our records system and retrieved all reports of DGSP performed over a 6-month period. For each procedure (one patient could have multiple procedures), we retrieved the record of the most recent same or similar procedure performed, without dermoscope guidance, on a sex-and-age (±5 years) matched control patient. Our interventions for the study and control procedures were with dermoscope guidance and without dermoscope guidance. We used retrospective data for both cases and controls.

Our primary outcomes were: (i) local inflammation and infection requiring treatment within 2 weeks after the procedures, (ii) incomplete removal of lesions or relapse of lesions within 6 months; and (iii) obvious scars (visible at a distance of 50 mm for perfect vision) within 6 months. Our secondary outcome was pain affecting activities of daily living in the first week following the procedure. We also asked the study participants whether they would opt for DG surgical procedures if indicated in the future.

We obtained informed written consent from all patients or parents or legal guardians for patients aged 18 years and younger to have the procedures done and to have their data included and analysed in this study.

Results

We retrieved clinical records of 39 DG surgical procedures performed for 36 patients in our practice: 21 (58%) were male and 15 (42%) female. They were aged from 7 to 89 years (mean age 48.5 years, standard deviation 20.9 years). The procedures were 22 excisional biopsies (56% of all procedures), five (13%) suturing, five (13%) laser ablations, five (13%) cauteries and two (5%) punch biopsies. The procedure used was with dermoscope guidance.

We matched control procedures. Their intervention was without dermoscope guidance. For a

punch biopsy on a patient with extra-mammary Paget's disease, we paired a control procedure on a patient with squamous cell carcinoma *in situ*. For the excisional biopsy on scrotal tumoural calcinosis, we paired an excisional biopsy for a scrotal epidermoid cyst. For excisional biopsy of a juvenile xanthogranuloma, we paired a control of an excisional biopsy on a patient with neurofibromatosis type I to relieve compression of a neurofibroma on an adjacent nerve.

The age of patients on which control procedures were performed ranged from 11 to 87 years (mean age 49.4 years, standard deviation 23.2 years). There was no significant difference between patients in the intervention and control groups (z-score: –0.97; $P = 0.33$). There were 22 male patients in the control group (47%) and 24 females (53%).

Dermoscope-guided excisional biopsies

The commonest histopathological diagnoses were seborrhoeic keratosis (six lesions; 27% of all DG-excisional biopsies), benign melanocytic naevi (five lesions; 23%) and viral warts (three lesions; 14%).

One excisional biopsy for a 7-year-old boy revealed juvenile xanthogranuloma.[1] When we first saw him he had a 1-year history of a solitary, firm and oval nodule on the anterior aspect of his right thigh, with enlargement during the previous 2 months. Dermoscopy with cross-polarisation revealed a well-structured mass with six to seven lobules (Fig. 3). Dermoscopic guidance achieved precise margins for complete excision and acceptable cosmetic outcome. Histopathology subsequently confirmed complete removal of the juvenile xanthogranuloma, with adequate margins. Immunophenotype of tumour cells was positive against cluster of differentiation 68 and negative against S100 proteins.

Dermoscope-guided suturing

Five (13% of all procedures) DG suturing procedures were performed, with four for accidental injuries with open wounds and one for a self-inflicted injury on the wrist. One suturing was for an 89-year-old female who had an accidental fall leading to open wounds on both sides of the nasal bridge, due to studs on her spectacles pressing into the sides of the nasal bridge.[3] The left-sided wound was deep and wide, and was near the left lacrimal sac and nasolacrimal duct. Unguided or blind suturing might damage these tissues and cause permanent epiphora. During DG suturing, we could visualise the entire route travelled by our 19-gauge needle from entry to exit points. While our needle tip passed through mucosal surfaces, we re-focused and could see the mucosal surfaces on the monitor. We ultimately made two sutures. There was no post-operative epiphora and the final cosmetic outcome was satisfactory.

Dermoscope-guided laser ablation and electrocautery

The indications for these procedures were for viral warts (six), acrochordons (two), and molluscum contagiosum (one). These interventions are commonly performed and considered appropriate in our part of the world.[6] We proceed only if the lesions cause symptoms affecting patients' activities of daily living. We counsel all patients on the natural courses of these diseases, the risks of recurrence and the implications of the Köbner phenomenon, where applicable.

Dermoscope-guided punch biopsy

A 54-year-old female with pemphigus vulgaris that was suspected clinically and serologically had one of the two punch biopsies. Dermoscopy guided us to the most indurating point at the margin of an erosion. Histopathology and direct immunofluorescence studies confirmed the diagnosis. The other punch biopsy was for a male aged 60 years with an extensive indurating plaque extending from the left inguinal crease to the scrotal wall, root of penis and left thigh.[2] We aimed to perform multiple biopsies, but financial constraints allowed only one biopsy, and a referral without a biopsy report to the public sector in our medical system would take many months, which would delay the management. After discussion with the patient, we decided to perform a DG punch biopsy on one site initially. During the procedure, we noted a site with reticular pattern and clumps of cherry-red dots, this was also the most severely indurated site. We

Table 1. Presentations, procedures, diagnoses and outcomes of 29 dermoscope-guided surgical procedures performed on 26 patients over a 6-month period
M, male; F, female

Patient #	Sex	Age (years)	Presentations and indications	Procedures	Final diagnoses	Surgical outcomes
01	M	50	Skin lesion on scalp	Dermoscope-guided (DG) excisional biopsy for histopathology	Seborrhoeic keratosis	Complete removal of lesion
02	M	65	Skin lesion lateral to right eye	DG excisional biopsy for histopathology	Viral wart	Complete removal of lesion
			Skin lesion on dorsal surface of distal interphalangeal joint of left middle finger	DG excisional biopsy for histopathology	Viral wart	Complete removal of lesion
03	M	42	Skin lesion on upper back	DG excisional biopsy for histopathology	Seborrhoeic keratosis	Complete removal of lesion
04	M	60	Large skin lesion on left groin extending from left inguinal crease to scrotal wall	DG deep intra-lesional punch biopsy for histopathology and immunohistochemical staining	*EMA+ CK7+ CK20+ Extramammary Paget's disease	Diagnosis confirmed, image investigations arranged, Wide-excision of the plaque with skin grafts
05	M	77	Skin lesion on posterior aspect of left cheek	DG excisional biopsy for histopathology	Irritated seborrhoeic keratosis	Complete removal of lesion
			Skin lesion on anterior aspect of left cheek	DG excisional biopsy for histopathology	Squamous papilloma	Complete removal of lesion
06	M	67	Acrochordons on anterior aspect of neck, known history with previous lesions sent for histopathological examination	DG electrocautery	Acrochordons	Complete cautery of lesions
07	M	84	Skin lesion on vertex of scalp	DG excisional biopsy for histopathology	Seborrhoeic keratosis	Complete removal of lesion
08	M	31	Suspected melanocytic naevus just superior to umbilicus	DG excisional biopsy for histopathology	Intradermal naevus	Complete removal of lesion
09	F	89	Open wounds on both sides of nasal bridge after accidental fall, adjacent to the left lacrimal sac and nasolacrimal duct	DG suturing	†Accidental injury with open wounds	Satisfactory cosmetic outcome, no injury to adjacent organs and tissues
10	M	38	Open wound on lateral aspect of left wrist, adjacent to tendons of extensor pollicis brevis and abductor pollicis longus	DG suturing	Accidental injury with open wounds	Satisfactory cosmetic and functional outcome, no injury to adjacent tissues
11	F	32	Plantar viral warts on soles causing pain on walking	Electrocautery	Viral warts	Complete cautery of all lesions

(Continued)

Table 1. Continued

Patient #	Sex	Age (years)	Presentations and indications	Procedures	Final diagnoses	Surgical outcomes
12	F	54	Chronic generalised discrete and painful skin erosions	Punch biopsy at margin of a large lesion on the back for histopathology and direct immunofluorescence studies	Pemphigus vulgaris	Diagnosis of pemphigus confirmed, systemic and topical treatments commenced
13	M	55	Skin lesion on right cheek Skin lesion on left aspect of forehead	DG excisional biopsy for histopathology DG excisional biopsy for histopathology	Benign hyperkeratotic lesion with no malignant feature Seborrhoeic keratosis	Complete removal of lesion Complete removal of lesion
14	F	26	Viral wart on radial aspect of distal interphalangeal joint of left finger, professional pianist	DG carbon dioxide laser ablation	Viral wart	Complete ablation of lesion
15	F	24	Junctional/compound melanocytic naevus on shoulder	DG carbon dioxide laser ablation (the patient declined excisional biopsy and was counselled on the risks incurred)	Junctional naevus	Complete ablation of lesion
16	M	27	Skin lesion on scrotal skin	DG excisional biopsy for histopathology	Tumoural calcinosis with no malignant feature	Complete removal of lesion
17	M	7	Skin lesion on anterior aspect of right thigh	DG excisional biopsy for histopathology and immunohistochemical staining	‡CD 68 + S100 – juvenile xanthogranuloma	Complete removal of lesion
18	M	37	Molluscum contagiosum on shaft of penis, history of similar lesions histopathologically confirmed to be molluscum	DG carbon dioxide laser ablation	Molluscum contagiosum	Complete ablation of lesion
19	M	14	Plantar viral warts on soles causing pain on walking	Electrocautery	Viral warts	Complete cautery of all lesions
20	M	50	Skin mass on left cheek	DG excisional biopsy for histopathology	Seborrhoeic keratosis	Complete removal of lesion
21	M	61	Skin lesion on left aspect of upper back	DG excisional biopsy for histopathology	Inverted follicular keratosis	Complete removal of lesion
22	F	54	Acrochordons on anterior aspect of neck and bilateral axillaries, known history with previous lesions sent for histopathological confirmation	DG electrocautery	Acrochordons	Complete cautery of lesions
23	F	24	Self-inflicted wound to ventral aspect of left wrist	DG suturing	Self-inflicted open wound	Satisfactory cosmetic and functional outcome, no injury to adjacent tissues

(Continued)

Table 1. Continued

Patient #	Sex	Age (years)	Presentations and indications	Procedures	Final diagnoses	Surgical outcomes
24	M	61	Skin mass on left aspect of scrotal skin	DG excisional biopsy for histopathology	Fibroepithelial polyp with no malignant feature	Complete removal of lesion
25	F	64	Skin mass on left forearm	DG excisional biopsy for histopathology	Neurofibroma	Complete removal of lesion
26	F	26	Viral wart on radial aspect of distal-interphalangeal joint on right middle finger, painful when writing	DG laser ablation	Viral wart	Complete ablation of lesion
27	F	41	Viral warts on hands and fingers affecting activities of daily living	Electrocautery	Viral warts	Complete cautery of all lesions
28	M	63	Skin mass on back with recurrent injuries while changing clothing	DG excisional biopsy for histopathology	Benign fibroepithelial polyp	Complete removal of lesion
29	F	77	Suspected compound/ intradermal melanocytic naevus on bridge of nose with recent enlargement	DG excisional biopsy for histopathology	Benign intradermal naevus	Complete removal of lesion
30	F	23	Open wound on upper lip after accidental fall injury	DG suturing, mostly on mucosal surface touching the teeth	Accidental injury with open wounds	Satisfactory cosmetic outcome, no injury to adjacent organs and tissues
31	F	83	Hyperkeratotic mass on left forearm with recurrent bleeding	DG excisional biopsy for histopathology	Benign hyperkeratotic lesion with acute inflammation	Complete removal of lesion
32	F	29	Viral warts on fingers affecting writing and other activities of daily living	DG carbon dioxide laser ablation	Viral wart	Complete ablation of lesion
33	M	49	Suspected acquired compound/ intradermal melanocytic naevus on right cheek with recent enlargement and feeling of irritation	DG excisional biopsy for histopathology	Intradermal naevus	Complete removal of lesion
34	M	49	Suspected flat viral wart anterior to right ear	DG excisional biopsy for histopathology	Viral wart	Satisfactory cosmetic outcome
35	F	69	Open wound lateral to lateral angle of right eye due to accidental fall with injured region hit against angle of a wooden chair	DG suturing	Accidental injury with open wounds	Satisfactory cosmetic outcome, no injury to adjacent organs and tissues
36	M	45	Skin mass on left lateral aspect of abdomen	DG excisional biopsy for histopathology	Benign compound naevus	78

J Eur Acad Dermatol Venereol.* 2017; **31: 1670–81.
†Australas J Dermatol. 2017; **58**. doi: 10.1111/ajd.12710.
‡Eur J Pediatr Dermatol. 2017; **27:** 134–7.

performed a thick punch biopsy. Histopathology suggested extramammary Paget's disease. Immunohistochemical staining revealed positivities against epithelial membrane antigen, cytokeratin 7 and cytokeratin 20, with negativities against S100 proteins, human melanoma black 45 and prostate-specific antigen. With these results, we promptly referred the patient for further investigations and management. Further investigation confirmed that our biopsy site was indeed the site with the highest yield of Paget cells and it had the most severe destruction of the architecture of the skin and underlying tissues. DG punch biopsy had elevated our precision as well as lowered the cost for the first procedure to define the diagnosis in the shortest possible time.

Comparison of the outcomes

For the primary outcomes (Table 1), we found no significant difference between study groups for localised inflammation or infection that required treatment, other acute complications within 2 weeks and subacute and chronic complications other than scarring within 6 months.

Incomplete removal of lesions or relapse within 6 months of the procedures were noted in two (6%) study procedures and nine (28%) control procedures (Risk Ratio (RR): 0.22, 95% confidence interval (CI): 0.05–0.95; $P < 0.05$). Obvious scars at 6 months were seen in 14 (36%) study and 27 (69%) control procedures (RR: 0.52, 95% CI: 0.32–0.83; $P < 0.05$).

For the 32 operations aiming to remove entire lesions (excisional biopsy, laser ablation and electrocautery), 20 lesions were <4 mm at the largest diameters. Out of these, five (25%) left obvious scars 6 months after surgery, significantly less than 10 (83%) lesions with scars out of 12 small lesions for the controls (RR: 0.30, 95% CI: 0.13–0.67; $P < 0.05$). For large lesions (≥4 mm), no significant difference was found (RR: 0.77, 95% CI: 0.40–1.47; $P = 0.47$).

Table 2. Primary and secondary outcomes for dermoscope-guided surgical procedures and control procedures with no dermoscope guidance performed for the same or most similar indications on age-and-sex pair-matched patients
Data are presented as n (%). RR, risk ratio; CI, confidence interval

	Study procedures – with dermoscope guidance	Control procedures – without dermoscope guidance	Analyses
Primary outcomes (*N* = 39 procedures)			
Local inflammation or infection requiring treatment within 2 weeks after the procedures	4 (10)	7 (18)	RR: 0.57, 95% CI: 0.18–1.80
Other acute complications 2 weeks after the procedures	2 (5)†	3 (8)†	RR: 0.67, 95% CI: 0.12–0 3.77
Incomplete removal of lesion or relapse 6 months after the procedures (for 32 procedures – excisional biopsy, laser ablation and cautery)	2 (6)	9 (28)	RR: 0.22, 95% CI: 0.05–0.95*
Obvious scars visible at a distance of 50 cm for perfect vision, present 6 months after the procedures	14 (36)	27 (69)	RR: 0.52, 95% CI: 0.32–0.83*
Other subacute and chronic complications 6 months after the procedures	0 (0)	1 (3)‡	RR: not applicable
Secondary outcomes (*N* = 36 patients)			
Pain affecting activities of daily living in the first week after procedures	6 (17)	5 (14)	RR: 1.20, 95% CI: 0.40–3.58
Would like to have dermoscope-guided operations for similar diseases in the future	32 (89)	Not applicable	Not applicable

*Statistically significant.
†Drug allergy for two study subjects and two control subjects; blood seeping due to dislodgement of sutures for one control subject.
‡Keloid formation on sternal skin.

For the secondary outcome, pain affecting activities of daily living in the first week was reported for six (17%) intervention and five (14%) control procedures. The difference was not significant (RR: 1.20, 95% CI: 0.40–3.58; $P = 0.74$). Most patients receiving DG procedures (32 (89%)) would choose DG procures again for treating similar diseases or injuries (Table 2).

Discussion

This research shows the usefulness of DG operations conducted in primary care. In the 6-month period of this study, we conducted 39 DG procedures. The findings in two of our primary outcomes – relapse in 6 months and scarring in 6 months – demonstrated the superiority of dermoscope guidance over usual care.

DG histologic sectioning, *ex vivo*, has been found to enhance yields of histopathological investigations.[7,8] DG surgical procedures, *in vivo*, have been reported for incisional biopsies,[9,10] excisional biopsy,[11] nail ablation[12] and in Mohs surgeries.[13–16] However, these studies were conducted in specialist settings and might not be applicable to primary care.

The retrospective nature of our study is an advantage. If we performed a prospective study, the performance of the GP could be affected by awareness of participating in research. Being retrospective, our study achieved masking (blinding before assessments) as well as allocation concealment (blinding during assessments).

This study also had a low likelihood of selection bias. The study time period of 6 months was predetermined, and all DG procedures performed within this period were studied. The control procedures without dermoscope guidance were the most recent procedures performed for the same or most similar indications in age-and-sex pair-matched patients. The investigators had no freedom to choose the controls, leading to virtually no selection bias.

A potential limitation could be the confounding variable of the experience and skills of the GP. The last control procedure was performed before the first study procedure. As the GP has performed more operations, he gained more proficiency than when he started. However, the GP has been performing similar surgical procedures in the same setting for more than 20 years. His technique should have plateaued by the time he performed the control and study procedures.

The most important limitation of the study is the low numbers of intervention and control procedures performed by one GP only, although this did eliminate the issue of inter-clinician performance and variation across clinical settings. However, this limits the generalisability of the results to other clinical settings and to other parts of the world.

Although we tried to match each study procedure with a control procedure with similar diagnosis and disease severity, there were heterogeneities we were unable to eliminate completely. Another limitation is that owing to the retrospective nature of the methodology, we have limited the patient-assessed outcomes to pain in the first week only, and treated this as a secondary outcome only. Patient-assessed outcomes are at least as important as clinician-rated outcomes.

DG surgery is relatively novel and is virtually unreported in primary care settings apart from our previous publications. We continued to perform DG surgical procedures as this study was being undertaken. We naturally focus on advantages of these procedures and may not therefore detect its adverse aspects. As responsible clinicians, we wished to study our work and we believe that the case-control approach to studying the outcomes of DG surgical procedures was the most feasible and robust approach to take.

Further studies might recruit more patients and involve more GPs. This would check the validity of our findings and enable assessment of inter-clinician variability. The training of GPs and assistants, quality of the equipment and cost-effectiveness should also be explored.

Dermoscopes are within reach for many GPs. Our experience is that proficiency in DG surgical procedures is relatively easy to attain if a GP is competent in dermoscopy. Performing these

procedures in primary care settings might also lower medical costs in the community.

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Competing Interests

The authors declare no competing interest.

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