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The efficacy of three different surgical techniques in the management of drug-induced gingival overgrowth

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Abstract

Objectives: The aim of the present study was to evaluate the efficacy of three different surgical techniques in both the management and effect upon rate of overgrowth recurrence of drug-induced gingival overgrowth (DIGO).

Materials and methods: Two cohorts of patients who required surgical correction of their DIGO participated in the study. After baseline periodontal measures (plaque index, gingival inflammation and probing pocket depths), the patients underwent surgery. A split-mouth, crossover design was used to compare conventional gingivectomy with flap surgery ($n = 27$), and conventional gingivectomy with laser excision ($n = 23$). The main outcome variable was the rate of recurrence of DIGO following surgery.

Results: At 6 months, there was significantly less recurrence ($p = 0.05$) in patients treated with laser excision, compared with those treated by conventional gingivectomy. The differences in rate of recurrence of DIGO were also reflected in changes in several periodontal parameters. Flap surgery offered no advantage over conventional gingivectomy with respect to the rate of recurrence.

Conclusions: DIGO can be managed by a variety of techniques. Laser excision results in a reduced rate of recurrence.

Key words: flap surgery; gingival overgrowth; gingivectomy; laser excision; management

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Surgical intervention is the most frequent management strategy for drug-induced gingival overgrowth (DIGO). For many patients the recurrence rate of DIGO is high (34%) and they are subjected to repeated surgical interventions to restore gingival contour (Ilgenli et al. 1999). These patients are medically compromised and spend considerable time within medical units monitoring and treating there primary condition. Gingival surgery is another of these events which consumes a patient's available time. The surgery itself carries a level of morbidity especially when undertaken on repeated occasions. Reducing the recurrence of DIGO and hence the need for surgery would clearly be advantageous for all parties.

Scalpel gingivectomy has been advocated as the standard treatment of choice in the management of DIGO (Rostock et al. 1986). Before this current investigation, there has been little information in the literature on the management of this unwanted effect (Hylton 1986, Pick & Colvard 1993). Flap surgery potentially removes the disadvantage of a large unprotected open intra-oral wound and so may result in reduced post-operative discomfort and bleeding. However, little is known about the effectiveness of this type of surgical approach in the management of DIGO. A second alternative to scalpel excision is the laser gingivectomy, which offers potential advantages of sterilization of the surgical field and reduced haemorrhage during excision. There is also the potential of prompt healing and minimal post-operative discomfort that has been described previously (Pick & Colvard 1993, Romanos & Nentwig 1996). There has been no comparative study of these surgical procedures in the management of DIGO. The aim of the present study, therefore, is to compare both laser gingivectomy and overgrowth flap surgery with the scalpel gingivectomy representing the current ''gold standard''.

The primary outcome measure was the recurrence of gingival overgrowth and the secondary outcomes included an evaluation of post-operative pain and patient preference. The null hypothesis being tested was that there was no difference for these outcomes between the current ''gold standard'' and laser or flap surgery in the surgical management of DIGO.

Material and Methods

The study was undertaken in two parts, each of which was a self-contained split-mouth study comparing flap surgery to scalpel gingivectomy in the first cohort and laser gingivectomy to scalpel gingivectomy in the second cohort. Solid organ transplant patients who required surgical excision of their DIGO were recruited for these studies. All patients presented with gingival overgrowth scores in excess of 30% (Seymour et al. 2000) affecting at least eight upper or lower anterior teeth. All patients were at least 3 months post-transplant, and medicated with the combination of ciclosporin or ciclosporin and a calcium blocking drug such as nifedipine. Patients were excluded from the study if they were suffering from a systemic disease that may affect the periodontium, were smokers, had a recent history of antibiotic treatment or had taken analgesics in the previous 7 days. All patients gave informed consent before participating. Details of patients' demographics, medication and duration of transplant were recorded.

Surgery

In each patient, one half of the anterior segment (bicuspid to central incisor region) was treated using the conventional scalpel gingivectomy and the other half was treated using flap surgery. The two surgical sites were treated at consecutive appointments (within 2 weeks of each other). The allocation of each surgical technique, the treatment order and the side that it was undertaken on was randomized using the random permuted block technique (Matthews 2000a, b). For the second phase an identical study construct was used where scalpel gingivectomy was compared with laser gingivectomy. The laser used in this study was a Dentec LD-15 diode laser with a wave length of 810 nm.

All surgical procedures were completed under local anaesthesia (4 ml lidocaine 2% with 1:80 000 epinephrine) and by the same operator (M.M.). Each surgical procedure was timed from first incision to pack placement. All surgical sites were dressed with Coe-Pack® (GC International Inc., Newport Pagnell, UK). Patients returned 1 week after surgery for pack and where appropriate suture removal. Each phase of the overall study had received appropriate ethical approval from the Local Research Ethics Committee.

Periodontal variables

At baseline (before surgery) all patients underwent a full periodontal screening. Their oral hygiene and gingival inflammation were assessed using plaque index of Silness & Löe (1964) and the papilla bleeding index (Saxer & Muhlemann 1975). Probing pocket depths were measured to the nearest millimetre at six points around each tooth (buccal: mesial, mid-point and distal; palatal/lingual: mesial, mid-point and distal). A Vivacare, pressure sensitive probe was used for all measurements. All measures were repeated at 1, 3 and 6 months post-surgery. After baseline measures patients were given detailed oral hygiene instructions and received a full-mouth prophylaxis.

Pain assessments

All patients were given a diary to record their pain experience in the first 60 h following excision. Pain intensity was assessed on serial 100 mm visual analogue scale (VAS) immediately on completion of surgery and then at 1, 12, 24, 30, 36, 48, 54 and 60 h thereafter. The boundaries of the VAS were anchored by the phrases ''no pain'' and ''unbearable pain''. Patients were prescribed acetaminophen tablets to control their post-operative pain if necessary. In the event of analgesics being taken, patients were asked to record the time and dose. An overall assessment of the patient's pain experience was achieved by calculating the area under the curve of serial VAS (Matthews et al. 1990).

Assessment of gingival overgrowth

Gingival overgrowth was assessed on plaster study models using the overgrowth index of Seymour et al. (1987). These scores were subsequently expressed as a percentage. Alginate impressions were taken from each patient 1 week after completion of surgery and also at 1, 3 and 6 months. Plaster models were scored by one assessor (J.M.T.) who was blinded to the surgical procedure.

Statistical analysis

Patient data including demographics, periodontal scores and pain variables were transcribed onto a spreadsheet and analysis was performed using commercially available software packages (Microsoft Office XP-Excel 2000 and SPSS version 11-2003). The primary outcome measure was the difference in gingival overgrowth scores and formed the basis of the power calculation. A clinically meaningful difference in overgrowth scores between two surgical techniques was defined as 15%. Using a split-mouth design, a sample size of 20 patients was required for each treatment comparison; based upon a two-tailed test, with an adjusted significance level of $\alpha = 0.025$ and $\beta = 0.20$ (Seymour & Smith 1991). Seven additional patients were recruited for the flap surgery phase and three additional patients for the laser surgery phase of the study to prevent the studies being underpowered if patients were lost during the assessment period.

Data was tested for normality using the Kolmogorov–Smirnov test and as the data were approximately normally distributed, the initial analysis was performed using the two-sample (paired) *t*-test (Armitage 1974).

Mean overgrowth scores were computed at each surgical site at 1, 3 and 6 months after surgery. Re-growth of the gingival tissue (recurrence) was assessed by reference to the baseline (1 week post-surgical) scores. This takes into account any variation in the amount of tissue that may have been excised using the three different surgical techniques. Changes in overgrowth scores from baseline to each the post-surgical time points were examined.

Differences in the rate of recurrence following the three surgical treatments were assessed using analysis of covariance (ANCOVA) with baseline overgrowth scores, plaque and bleeding indices incorporated as covariates and the dependent variable being the gingival overgrowth scores between treatments at 1, 3 and 6 months post-operatively. At consecutive stages in the analysis, demographic and pharmacological variables were introduced, one at a time in this model to ascertain whether they contributed to the recurrence of overgrowth after each treatment.

Paired *t*-tests were used to compare difference in area under the curve (AUCs) for each treatment group. Time to first administration of rescue analgesic was compared between treatments using Cox's proportional hazard method (Altman 1991a, b).

Results

Demographic details and relevant medical and drug histories of patients in the two phases of the study are shown in Table 1. Twenty-seven patients consented and completed the first phase of the study comparing flap surgery with scalpel gingivectomy, and 23 patients were recruited and completed the second phase comparing scalpel and laser gingivectomies.

Mean gingival overgrowth scores (± SD) and 95% confidence intervals at the respective time points are shown in Table 2. Mean re-growth scores, reflecting gingival changes from baseline (1 week post-surgery) are shown in Table 3.

There were no significant differences in gingival overgrowth scores between treatment sites for the pre-surgical scores or at any time during the 6-month observation period, (Table 2), (individual *p*-values are not shown). Likewise for re-growth of gingival tissue, there were no differences ($p = 0.353$) between flap surgery and scalpel gingivectomy, however, at 1-month post-surgery, the change in overgrowth score from baseline (1 month – baseline) was significantly higher ($p = 0.038$) after scalpel gingivectomy but there was no significant difference at either 3 or the 6 month time points (Table 3). By contrast, in the second phase gingival overgrowth recurrence was significantly greater in patients undergoing the scalpel gingivectomy when compared with laser gingivectomy at 1, 3 and 6 month post-surgery ($p \leqslant 0.05$) (Table 3).

Periodontal variables

Before surgery, no significant differences were identified for any of the recorded periodontal variables between treatment groups ($p > 0.05$) (Tables 4–6). However, baseline data for plaque and bleeding scores were different, but not at the level of statistical significance between treatment groups. These differences in baseline scores were incorporated into the ANCOVA model to ensure that they were considered into the analysis of the main outcome variable, notably the recurrence of DIGO. At 6 months post-operatively, the post-surgical plaque scores were significantly

Table 1. Demographic and pharmacological variables for patients in both phases

	Mean ± SD	
	scalpel gingivectomy *versus* flap surgery	laser *versus* scalpel gingivectomy
Age (in years)	47 ± 12.5	43.5 ± 11
Time since transplantation (years)	8.2 ± 4.4	8.1 ± 3.5
Weight (in kg)	87.04 ± 22.1	82.7 ± 18.8
Ciclosporin dose (mg/day)	255.6 ± 60.6	244.6 ± 75.7
Ciclosporin blood concentration (μmol/l)	141.9 ± 49.2	137.4 ± 53.4
Creatinine serum concentration (μmol/ml)	136.4 ± 33.4	143.3 ± 45.2
Sex (M/F)	26 (96.3%) /1 (3.7%)	21 (91.3%) /2 (8.7%)
Transplant type (kidney/heart)	17 (62.9%) /10 (37.03%)	15 (65.2%) /8 (34.8%)
Ca channel blocker (yes/no)	22 (81.5%) /5 (18.5%)	21 (91.3%)/2 (8.7%)
Azathioprine (yes/no)	17 (62.9%) /10 (37.03%)	14 (60.9%) /9 (39.1%)
Prednisolone (yes/no)	24 (88.8%) /3 (11.2%)	19 (82.6%) /4 (17.4%)
Time for Surgery (min.)	Scalpel 26.7 ± 4.5 Flap 37.6 ± 5.9	Laser 22.6 ± 4 Scalpel 25 ± 6

Table 2. Gingival overgrowth mean scores before and immediately after surgery (baseline) and at 1,3 and 6 months post-operatively

	Mean ± SD		Difference: mean ± SD (95% CI)	Mean ± SD		Mean ± SD (95% CI)
	flap	scalpel		laser gingivectomy	scalpel gingivectomy	
Before surgery	38.8 ± 16.2	40.6 ± 16.6	− 1.8 ± 1.32 (− 7, 0.17)	45.6 ± 14.8	4.56 ± 15	0.16 ± 6.7 (− 2.8, 3.2)
After surgery	15.2 ± 9.6	12 ± 9.2	3.2 ± 11.2 (− 1.2, 7.6)	9.2 ± 11.6	8.4 ± 10.4	0.9 ± 6.52 (− 2, 4)
1 month	17 ± 9.4	18.4 ± 10.8	− 1.4 ± 11.8 (− 6.2, 3.4)	14.6 ± 13.8	18.2 ± 14.8	− 3.4 ± 12.4 (− 9, 2)
3 months	25.2 ± 15.2	26.2 ± 15.4	− 1 ± 11.4 (− 5.6, 3.6)	21.8 ± 14	28.4 ± 17	− 6.6 ± 15 (− 13.4,0.06)
6 months	33.4 ± 19.8	32.8 ± 17.6	0.6 ± 14.6 (− 5.2, 6.2)	31 ± 16.2	37.6 ± 19.4	− 6.6 ± 17.6 (− 14.4, 1.4)

Table 3. Post-operative gingival overgrowth scores reflecting changes from baseline (after surgery)

Re-growth after surgery	Mean ± SD		Mean difference (95% CI)	*p*-value	Mean ± SD		Mean difference (95% CI)	*p*-value
	flap	scalpel gingivectomy			laser gingivectomy	scalpel gingivectomy		
1 m − B/L	2 ± 11	6.2 ± 8.2	− 4.2 ± 9.8 (− 0.41, − 0.2)	0.038	5.4 ± 10.8	9.8 ± 11	− 4.4 ± 9.04 (− 8.4, − 0.38)	0.033
3 m − B/L	10.2 ± 15.8	14.4 ± 11.2	− 4.2 ± 11.2 (− 8.6, 0.2)	0.065	12.6 ± 10.6	20.2 ± 10.8	− 7.6 ± 13.7 (− 13.64, − 1.5)	0.017
6 m − B/L	18.2 ± 18.8	20.8 ± 13.2	− 2.6 ± 11.4 (− 7.2, 1.8)	0.225	21.8 ± 12.4	29.2 ± 14.6	− 7.4 ± 16.78 (− 14.86, − 0.02)	0.05

B/L, Baseline.

Table 4. Plaque scores

	Mean+SD		Mean difference (95% CI)	*p*-values	Mean+SD		Mean difference (95% CI)	*p*-value
	flap surgery	scalpel gingivectomy			laser gingivectomy	scalpel gingivectomy		
Before surgery	1.36 ± 0.38	1.36 ± 0.39	0.001 ± 0.14 (– 0.05, 0.06)	0.96	1.41 ± 0.41	1.46 ± 0.41	– 0.044 ± 0.21 (– 0.14, 0.05)	0.335
1 m	0.45 ± 0.42	0.46 ± 0.42	– 0.018 ± 0.14 (– 0.08, 0.04)	0.54	0.39 ± 0.41	0.55 ± 0.43	– 0.16 ± 0.07 (– 0.30, – 0.01)	0.037
3 m	0.81 ± 0.36	0.79 ± 0.38	0.02 ± 0.16 (– 0.04, 0.09)	0.38	0.64 ± 0.43	0.95 ± 0.37	– 0.305 ± 0.43 (– 0.50, – 0.11)	0.0035
6 m	0.99 ± 0.45	0.91 ± 0.42	0.08 ± 0.17 (0.01, 0.14)	0.021	0.99 ± 0.43	1.21 ± 0.31	– 0.225 ± 0.40 (– 0.41, – 0.05)	0.016

Table 5. Bleeding scores

	Mean+SD		Mean difference (95% CI)	*p*-values	Mean+SD		Mean difference (95% CI)	*p*-value
	flap surgery	scalpel gingivectomy			laser gingivectomy	scalpel gingivectomy		
Before surgery	2.76 ± 0.55	2.82 ± 0.57	– 0.06 ± 0.22 (– 0.14 to 0.03)	0.204	2.92 ± 0.72	3.06 ± 0.67	– 0.14 ± 0.33 (– 0.29, – 0.003)	0.06
1 m	1.16 ± 0.56	1.53 ± 0.48	– 0.37 ± 0.61 (– 0.61 to -0.12)	0.005	0.83 ± 0.79	1.09 ± 0.85	– 0.26 ± 0.403 (– 0.44, – 0.086)	0.006
3 m	2.1 ± 0.65	2.1 ± 0.64	0.006 ± 0.6 (– 0.23 to 0.24)	0.958	1.78 ± 0.71	2.48 ± 0.63	– 0.7 ± 0.76 (– 1.04, – 0.37)	0.0003
6 m	2.8 ± 0.73	2.39 ± 0.68	0.44 ± 0.6 (0.2 to 0.67)	0.001	2.2 ± 0.66	2.92 ± 0.62	– 0.72 ± 0.72 (– 1.05, – 0.405)	0.0001

Table 6. Probing pocket depth scores

	Mean ± SD		Mean difference (95% CI)	*p*-values	Mean ± SD		Mean difference (95% CI)	*p*-value
	flap surgery	scalpel gingivectomy			laser gingivectomy	scalpel gingivectomy		
Before Surgery	4.01 ± 0.52	4.13 ± 0.62	– 0.12 ± 0.41 (– 0.28, 0.043)	0.143	4.47 ± 1.24	4.53 ± 1.31	– 0.061 ± 0.51 (– 0.29, 0.16)	0.579
1 m	2.11 ± 0.54	2.6 ± 0.6	– 0.46 ± 0.55 (– 0.68, – 0.24)	0.0001	2.7 ± 0.55	3.05 ± 0.604	– 0.342 ± 0.41 (– 0.53, – 0.16)	0.001
3 m	3.12 ± 0.82	3.14 ± 0.78	– 0.02 ± 0.75 (– 0.31, 0.28)	0.91	2.95 ± 0.64	3.62 ± 1.029	– 0.67 ± 0.68 (– 0.97, – 0.37)	0.0001
6 m	3.61 ± 0.74	3.63 ± 0.65	– 0.02 ± 0.75 (– 1.32, 0.27)	0.89	3.33 ± 0.78	4.03 ± 1.183	– 0.7 ± 0.97 (– 1.13, – 0.27)	0.003

higher in the flap-treated surfaces ($p = 0.021$) than those treated by scalpel gingivectomy. At 1, 3 and 6 months post-surgery, the laser gingivectomy sites had significantly higher plaque scores when compared with the scalpel gingivectomy (Table 4).

By contrast, bleeding scores were significantly higher ($p = 0.005$) in the scalpel gingivectomy group at 1 month and 6 months post-surgery when compared with the flap-treated sites, and also in the scalpel gingivectomy group at 1, 3 and 6 months when compared with laser gingivectomy (Table 5). Probing pocket depths were significantly higher ($p > 0.0001$) 1 month after scalpel gingivectomy when compared with flap surgery, and at all time points were significantly higher in scalpel gingivectomy when compared with laser (Table 6).

Patients reported significantly more pain ($p = 0.04$) after flap surgery than after scalpel gingivectomy. The pain experience for laser and scalpel gingivectomies as shown by the AUC's in Table 7 were similar. Despite differences in pain scores, analgesic consumption was comparable for both treatments in each phase of the study. The flap procedure took longer than the scalpel gingivectomy but there were no differences in patients' preference, for the two treatments. However, 17 patients expressed a preference for laser gingivectomy compared with four patients preferring scalpel gingivectomy; two patients expressing no preference.

Discussion

The primary aim of this study was to determine the efficacy of different surgical techniques on the recurrence of DIGO in organ transplant patients. The conventional scalpel 45° gingivectomy was used as the standard approach. The DIGO model enables the use of a split-mouth design thus eliminating a range of co-factors that can affect outcomes. Trials of this nature are difficult to complete under double-blind conditions but the use of study models to assess gingival overgrowth facilitated blinding of this component as these were scored independently (J.M.T.) of the clinical operator (M.M.) and the procedure. It would have been impractical and inappropriate to carry out both arms of each study on the same patient at the same time. This meant that for one site the immediate post-surgical gingival overgrowth scores were taken at 2 weeks for one site and 1 week for the other. Possible potential differences that this may induce were controlled by the randomization process.

In the first part of the study there was less overgrowth at 1 month following

Table 7. Pain variables and patient preference scores

Variable	Flap	Scalpel gingiivectomy	Mean difference ± SD (95% CI)	*p*-value	Laser gingivectomy	Scalpel gingivectomy	Mean difference ± SD (95% CI)	*p*-value
Mean AUC (cm^2) ± SD	57.6 ± 72.8	31.9 ± 48	25.7 ± 61.7 (1.31, 50.1)	0.04	41.4 ± 80.6	28.4 ± 47.1	13 ± 87.3 (− 25.7, 51.8)	0.49
Analgesic consumption Yes/No	4/23	4/23	(0.018, 54.64)	1	6/17	4/19	– (0.457, 6.53)	0.39
Patient's preference	11	11	–	–	17	4	–	–

flap procedure compared with scalpel gingivectomy (Table 3). This may be due to the nature of the technique as flap surgery tends to result in the removal of more inter-proximal tissue than gingivectomy. It has also been suggested that the augmented recurrence of gingival overgrowth following gingivectomy can be attributed to the effects of ciclosporin and nifedipine on the surface of the more extensive and unprotected healing area (Pilloni et al. 1998). The authors also suggested that cellular mitotic activity starts from within the gingival connective tissue following flap surgery and therefore more time may be required for gingival enlargement to manifest itself clinically as compared with scalpel gingivectomy. Differences in periodontal variables (Tables 4–6) are probably a reflection of the overgrowth recurrence; change in gingival contour is likely to lead to plaque retention followed by gingival inflammation and increased probing pocket depths (Seymour et al. 2000).

Patients experienced more post-operative pain after the flap procedure than after gingivectomy (Table 7). The prevalence and severity of post-operative pain after periodontal surgical procedures is not clearly established. An extensive study involving 200 patients suggested that those who had undergone periodontal flap surgery experienced more pain than those who had undergone gingivectomy procedures (Strahan & Glenwright 1967). This finding was also supported in a study investigating post-operative pain following several different dental and oral surgical procedures (Seymour et al. 1983a, b). The differences in pain experience may be related to the raising of a mucoperiosteal flap and subsequent suturing. Nevertheless, the post-operative pain scores were low for both surgical procedures and this is reflected in the need for post-operative analgesia.

Laser surgery appears to have a significant impact on the rate of recurrence of gingival overgrowth when compared with scalpel gingivectomy (Tables 2 and 3). The sustained lower post-operative gingival re-growth in the laser treated surfaces may suggest a specific response towards this treatment modality. It may be attributable to decrease collagen production by gingival fibroblasts and/or to a delay in the healing process. The high energy Nd:YAG laser suppresses collagen production in fibroblasts cell culture. The action is mediated by a laser-induced action on the enzymatic reactions controlling the synthesis and breakdown of collagen (Abergel et al. 1984a, b). The diode laser used in the present study has a wavelength of 810 nm. This value lies in between those of the low-energy lasers and the high-energy Nd:YAG laser. It was made available to the authors to evaluate its use in the management of DIGO and other soft tissue procedures.

Laser treatment on oral soft tissues results in a thin layer of carbonized tissue and the formation of a collagen slough that protects the underlying tissue (Romanos & Nentwig 1996). Cellular mitotic activity starts from within the connective tissue following laser gingivectomy (Darbar et al. 1996), and therefore more time may be required for gingival enlargement to manifest itself clinically as compared with scalpel gingivectomy. The rate of gingival changes between 1 and 3 months was less than that between 3 and 6 months, but this was not the same for gingival bleeding. This would suggest that the occurrence of gingival bleeding (inflammation) is a precursor to the development of gingival overgrowth.

Between 3 and 6 months the pattern of progression of re-growth in both laser and gingivectomy arms was essentially parallel. As there was no significant difference in baseline overgrowth scores, the parallel pattern of gingival re-growth in these later stages may suggest an actual difference between both treatments, but a difference that occurs in the first few months post-surgery only. These findings may be further supported by the periodontal data which progressed in an approximately similar manner to the overgrowth scores at the 3 and 6 month interval. (Tables 4–6).

It has been suggested that laser gingivectomy offers the potential advantage of minimal post-operative discomfort and time spent to complete the procedure (Pick & Colvard 1993, Romanos & Nentwig 1996). Our findings in part support this view, although after laser surgery patients experienced slightly more pain than with the scalpel gingivectomy as reflected by the need for post-operative analgesia (Table 7). These differences in post-operative pain experience may be due to laser-inflicted thermal burns on the gingival tissues.

In this study we have compared different surgical excision techniques in the management of DIGO. Our main focus has been on the rate of recurrence of gingival overgrowth following the different techniques. From this perspective, there are advantages of laser excision, but this needs to be balanced against the slight increase in post-operative pain and the extensive cost of such equipment. It remains questionable whether the laser should displace the scalpel gingivectomy as the optimal treatment for the management of DIGO. However, if there is an underlying problem with haemostasis then laser excision does afford some distinct advantages.

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Clinical Relevance

Scientific rationale for the study: Several surgical techniques are available for the management of DIGO, but little is known about the impact of these different procedures on the rate of recurrence of DIGO.

Principle findings: Flap surgery and conventional gingivectomy provided similar results with respect to the rate of recurrence of DIGO. Laser excision resulted in a much lower rate of recurrence when compared with conventional gingivectomy. This difference was apparent at 1, 3 and 6 months post-operatively.

Practical implications: While there are advantages in using a laser in the management of DIGO, its cost may limit widespread use of this surgical approach. Our findings do confirm that conventional gingivectomy is an appropriate treatment for most patients with DIGO.