

Factors affecting decision making at reassessment of periodontitis. Part 4: treatment options for residual periodontal pockets

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Key points

A variety of treatment options are available for residual probing depths. These are indicated by the factors discussed in the last two papers in this short *BDJ* series.

Treatment can be non-surgical or surgical with various options outlined.

Provides general dental practitioners with an indication of specialist treatment that could be required.

Abstract

This paper is the final in a four-part series outlining treatment planning at periodontal reassessment. The first article (part 1) focused on the information that should be gathered at the reassessment appointment. Parts 2 and 3 discussed systemic and local factors that can relate to residual periodontal probing depths. Treatment can involve a range of non-surgical and surgical approaches. A variety of general, practical and local site factors can affect the choice of one option over another in choosing the most predictable treatment option. Decision-making can be challenging and this paper aims to aid this process by discussing the assessment of prognosis, factors that need to be considered in decision-making and treatment options available. A flow chart to summarise this process is presented.

Introduction

Once all of the data have been gathered at reassessment and an understanding of the specific reasons for residual periodontal probing depths has been undertaken, the prognosis can be updated. This information can then be used to carry out a treatment options appraisal in consultation with the patient.

Assessing prognosis

Prognosis is a prediction as to the progress, course and outcome of a disease.¹ Assessing prognosis is a fundamental yet challenging aspect of periodontal treatment planning. The benefit of revisiting this at the reassessment stage is that the patients' response to initial

therapy can be gauged and factored into the decision-making process. All of the factors discussed in the previous articles in this series should be considered when making a prognostic assessment, as summarised in Table 1. This should have been performed at initial assessment and revised at reassessment depending on the findings. Prognosis should be made at a tooth and an overall dentition level. The overall dentition is given a prognosis before individual teeth as the former can affect the latter. There are several prognostic classifications. The authors deem teeth with a hopeless prognosis as 'irrational-to-treat'. These teeth may already have been extracted as part of initial therapy. If not, their extraction should be planned at reassessment. Teeth with a questionable prognosis usually require further treatment and attempts should be considered to improve the prognosis of these teeth. Teeth with a secure prognosis should be maintained through supportive periodontal therapy (SPT). Only secure prognoses can be accurately made and those of single rooted teeth are generally more accurate.^{2,3}

In addition to the factors discussed in previous articles, the age of a patient can give an indication of prognosis as when comparing a

younger and older patient with similar levels of attachment loss, the younger will likely show a less predictable outcome to treatment. The extent of clinical attachment loss (CAL) also affects prognosis; however, this could be improved in intra-bony defects amenable to regeneration. Tooth mobility could also affect prognosis and mobile teeth that provide function or aesthetics may be splinted only to provide patient comfort and do not improve the long-term prognosis of teeth. Differential movement of splinted teeth usually leads to fracture of the splint and so must be carefully monitored.

Ultimately, gauging prognosis is a somewhat subjective process relying on a clinician's clinical experience, knowledge of evidence, clinical skills and thought process. Risk factor assessment tools have been developed to aid determination of prognosis and shown promising results.⁴

Treatment options for residual periodontal pockets

Following clinical assessment and determination of prognosis where residual deep probing depths remain, the factors

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summarised in Figure 1 need to be considered and balanced together to decide upon which treatment option is ultimately undertaken. There are a myriad of treatment options for the management of residual probing depths and decision-making is rarely straightforward. No set protocol for periodontal treatment planning can be stringently followed but the information within this and the previous articles may help a clinician to progress through a thought process. Where a case has residual probing depths despite immaculate oral hygiene and repeated non-surgical periodontal therapy, the general dental practitioner would be prudent to consider referral for specialist consideration of some of the options outlined in this paper. These can be divided into extraction, non-surgical and surgical (corrective) periodontal therapy options. Surgical options can only be considered where oral hygiene is maintained at a consistently optimal level and inflammation is minimal to facilitate the surgical procedure and ensure predictable long-term outcomes.⁵

Extractions

Symptomatic teeth with a hopeless prognosis should be extracted. Where a patient has only few teeth remaining and those of strategic importance require extraction, then consideration may be given to extraction of other additional teeth also if they will not provide prosthodontic function. Strategic extractions should also be considered where the close proximity of a tooth with a poorer prognosis and/or reduced functional and aesthetic roles compromises professional and self-performed access for cleaning (see Fig. 8 from Part 1 of this series). Evidence regarding the likely long-term effect of teeth with a hopeless prognosis on adjacent teeth is contradictory; however, where residual probing depths persist between two teeth with one tooth serving less purpose, extracting one of the two can resolve active disease on the remaining adjacent tooth.^{6,7,8,9} Where both teeth provide function, the authors suggest more emphasis on maintaining both teeth. This is often seen in second or third molar teeth that are unopposed or over-erupted. In the authors' experience, maintaining these teeth when periodontally compromised can jeopardise those mesial to them, they are unlikely to act as solid abutments to avoid free-end saddles in the future and are often not indicated for replacement if missing.

Table 1 Factors affecting tooth prognosis

Systemic factors	Periodontal factors	Prosthodontic factors	Endodontic factors
Patient compliance	Symptoms	Caries	Loss of vitality
Plaque control	Plaque	Functional or non-functional tooth	Combined endodontic-periodontic infection
Smoking	Calculus	Over-eruption	Root resorption
Disease severity	Periodontal probing depths	Abutment tooth or not	
Patient age	Bleeding/suppuraton on probing	Occlusal trauma	
Systemic disease	Tooth mobility	Aesthetics	
Stress	Furcation involvement	Tooth surface loss	
Mouth breathing/xerostomia	Bony defects		
Alcohol intake	Subgingival/defective restorations		
Diet	Root length, size and divergence		
	Root concavities		
	Root proximity		
	Developmental grooves		
	Bifurcation ridges		
	Cervical enamel projections		
	Enamel pearls		
	Access		
	Disease severity		

Where teeth of hopeless or poor prognosis are asymptomatic and not compromising those adjacent to them, the patient may wish to maintain them. If the mobility is uncomfortable for the patient consideration can be given to splinting. These teeth can be kept for many years longer than their initial prognosis suggested if stringently maintained.^{2,3}

Where a number of teeth require extraction, they may be extracted sequentially in order to allow the patient time to adjust to an immediate denture in phases. If an immediate denture is indicated, extractions may need to be delayed until the patient has optimised their plaque control to avoid an exacerbation of the periodontal condition associated with increased plaque build-up on removable prostheses.¹⁰

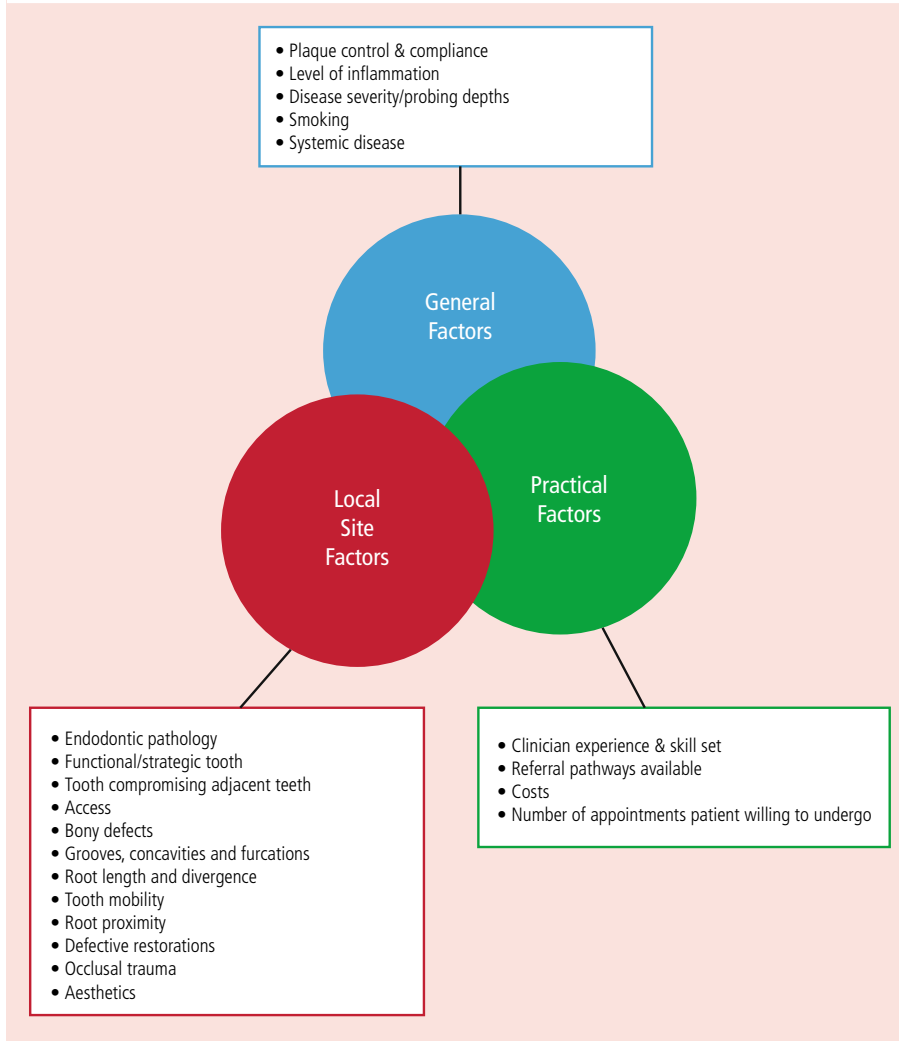
Where immediate dentures are indicated, a cleansable design should be provided.

An in-depth discussion of prosthetic treatment options for periodontal patients is outwith the scope of this paper; however clinicians may consider replacing periodontally compromised teeth with implants provided there is periodontal stability following extraction of

the relevant teeth. This decision will be based on the prognosis of the tooth or teeth in question. However, periodontally compromised teeth that are well maintained show survival rates of over 90% over ten years, although this is lower if the teeth are root treated.¹¹ This is comparable to the survival rates of dental implants with a ten-year implant and restoration survival rate of over 90% for crowns and bridges constructed from porcelain-fused to metal.^{12,13} These studies report 5-year single implant crown complication rates of 9% for screw loosening, 7% for soft tissue issues, 4% for loss of retention and 3.5% for veneer fracture. Additionally, 5-year implant bridge complication rates are reported as 13% for veneer fracture and 7% for aesthetic issues. Prevalence of peri-implant mucositis is estimated at 43% (confidence interval 32–54%) and peri-implantitis at 22% (confidence interval 14–30%) at implant level.¹⁴

A history of periodontitis is well established as a risk factor for peri-implantitis and management of peri-implantitis is unpredictable.^{15,16} Maintaining furcation involved molar teeth may also be more cost-effective than replacing them with

Fig. 1 Key decision-making factors for non-surgical or surgical management of residual probing depths



single implant crowns.¹⁷ When factoring the multiple complications associated with dental implants and their restorations, maintaining teeth and delaying implant treatment is often sensible. This suggests it is better to maintain asymptomatic teeth with supportive periodontal therapy for as long as possible unless specific indications for extraction, including the strategic reasons mentioned above, are present. Where a tooth is showing persistent progressive bone loss, that if left to proceed would compromise a potential implant site, then extraction should be considered.

Non-surgical options

Non-surgical periodontal therapy (NSPT)

As mentioned in the third article in the section on residual calculus deposits, repeating NSPT can be beneficial due to improved access to remove deposits as a result of shallower probing depths. Deposits that were previously subgingival can become supragingival which

also aids access. Patients who have shown improvement in their self-performed plaque control but not yet to an ideal level, may well also benefit from repeated NSPT in order to disrupt the bacteria and allow further patient contact to monitor and re-enforce oral hygiene measures. This is not a useful tactic for patients showing poor compliance, however, as it can result in the patient shifting the responsibility for disease stabilisation onto the clinician rather than taking ownership themselves. In the authors' experience, more than three courses of repeated NSPT in compliant patients very rarely yields further improvements in residual probing depths. Repeated courses of NSPT show equivocal benefits in the literature, especially for anterior teeth.^{18,19}

Antimicrobials

These can only be used concurrently with NSPT as adjuncts and are either locally or systemically administered. Issues with systemic

antimicrobials include antibiotic resistance, systemic side effects and a risk of anaphylaxis. These are hence only indicated where evidence suggests a definite benefit. Systemic antimicrobials have no clear benefit in the management of the majority of periodontitis cases and hence generally should not usually be prescribed.^{20,21,22,23} Systemic antimicrobials have traditionally been indicated in the previous 1999 classification of 'aggressive periodontitis'.²⁴ Where this classification has now been removed, clarification is required regarding which cases under the new classification should be prescribed systemic antimicrobials.²⁵ From a pragmatic perspective, systemic antimicrobials could be considered in severe cases of generalised periodontitis with obvious active disease despite immaculate oral hygiene; however, further guidance is required for absolute indications according to the new classification.

Local antimicrobials may give some minimal benefit in residual probing depths but clear indications are not currently accepted. They can be considered for localised sites in cases with immaculate oral hygiene:

- In sites of moderate probing depths where no deposits are evident in a bid to avoid surgery, for example, in anterior teeth in patients with a high smile line and gingival show
- To decrease the level of inflammation in order to consider surgery
- Where surgery is contraindicated due to a lack of keratinised gingivae
- In recurrence of active disease during SPT where NSPT has been unsuccessful.^{23,26}

A systematic review has shown local antimicrobials achieve a greater reduction in probing pocket depths (PPDs) (0.4 mm) and CAL (0.3 mm) compared with NSPT alone, with no difference in bleeding on probing.²⁶ Most of the included studies assessed the outcome from the first course of periodontal therapy and hence local antimicrobials should be considered with caution at reassessment. The same study reported that tetracycline fibres, doxycycline and minocycline showed benefits in PPD reduction. Sustained or repeated delivery are prerequisites for an effect. A range of local antimicrobials are available and the decision as to which one to choose will often come down to operator experience and availability in addition to interpretation of the available evidence base. Further good quality research is required to clarify the exact benefits. Other issues with

local antimicrobials include their added costs, potential for physical distention of the pocket and variable activity in sites.

Supportive periodontal therapy (SPT)

As mentioned in the second part in this series, under the section on interpretation of clinical findings, SPT has been well validated as beneficial to long-term tooth maintenance. This involves performing a six-point pocket chart and full mouth debridement using local anaesthesia for residual probing depths. It has been suggested this should be provided on a 3- to 4-monthly basis where residual probing depths remain, as at 3 months there will be bacteria at the base of a deep pocket no matter how well the patient maintains their oral hygiene.²⁷ The timing is inherently case specific however, with some clinicians preferring to see a long-term stable patient on an annual basis. In certain cases, despite localised moderate residual probing depths the decision may be undertaken to enter an SPT programme in order to maintain teeth that are not amenable to alternative options to stabilise the probing depths in the presence of excellent oral hygiene and minimal signs of inflammation when NSPT has been exhausted. This is often seen around molar teeth with furcation involvement and as mentioned previously these teeth may well survive for a number of years. Another indication is in patients who choose not to undergo corrective surgery.

Surgical options

Access flaps

Access flaps (also known as open flap debridement) are a conservative method of gaining direct access to the root surfaces for debridement with little or minimal soft tissue resection and osseous recontouring.²⁸ Types of access flap are summarised in Figure 2. Indications include:

- Improved access is required compared to NSPT
- A crater defect is present without an obvious soft tissue component to the residual probing defect
- A crater is present and inadequate keratinised gingivae is present for resective surgery
- In anterior teeth where soft tissue resection is contra-indicated due to aesthetic issues
- Adjustment of a root groove
- Regeneration not feasible and resective treatment would significantly jeopardise the level of supporting bone

Fig. 2 Classification of access flaps (From Graziani F, Karapetsa D, Mardas N, Leow N, Donos N. Surgical treatment of the residual periodontal pocket. *Periodontol 2000* 2018; 76: 150–163,⁴⁹ used with permission John Wiley & Sons)

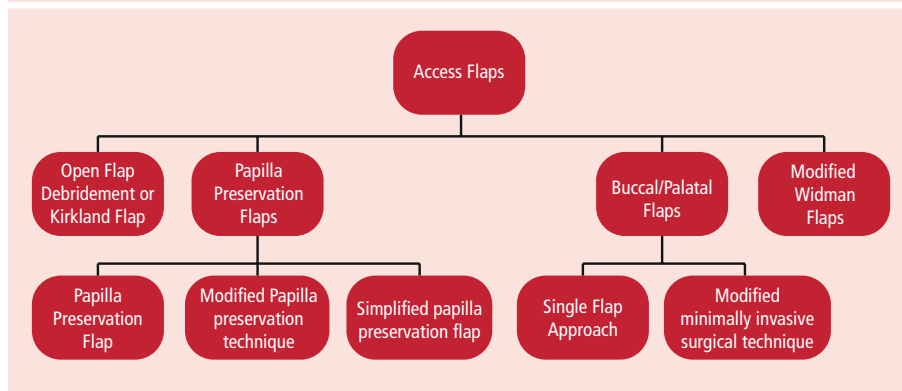


Fig. 3 Upper left quadrant residual periodontal probing depths treated via resective periodontal surgery. (A) Pre-operative photograph; (B) Pre-operative radiograph; (C) Uneven bony contour on raising flap (D) Elimination of bony defects by osseous recontouring; (E) Site closure; (F) 1-year review; (G) Radiograph at 1-year review

- Surgical examination of a defect with the potential for regeneration or resection.

Access flaps have shown periodontal probing depth (PPD) reductions of 2.85 mm over 12 months (95% confidence interval 2.47–3.22) for initial PPDs of 6.74 mm in intra-bony defects with complete elimination of residual probing depths in some cases.²⁸ In suprabony defects PPD reductions of 1.41 mm can be expected with access flaps.²⁹ In class II furcation defects, PPD reductions of 1.38 mm at 6 months following access flaps have been reported.³⁰ A systematic review comparing surgery with NSPT with a focus on access flaps found that at 12-month follow-up, surgery resulted in 0.6 mm more PPD reduction and 0.2 mm more CAL gain than NSPT in pockets deeper than 6 mm. In 4–6 mm pockets NSPT resulted in 0.4 mm more attachment gain and 0.4 mm less probing depth reduction than surgical therapy.³¹ At a follow-up post 12

months there was no evidence of a difference; however the attrition rate was high so there could well be a longer-term difference that has not been established through research yet. A sub-group of resective surgery with osseous recontouring showed more PPD reduction and increased CAL compared with open flap debridement alone.

Osseous resective surgery

This involves removal of attached gingivae in addition to modification of the bony support of the teeth, either in the form of osteoplasty whereby the alveolar process is reshaped to achieve a more physiologic form without removing supporting bone or ostectomy where supporting bone is removed.¹ If keratinised gingivae is limited, the alternative to soft tissue resection is to shift the whole soft tissue apparatus apically utilising an apically repositioned flap. The aim is to re-establish normal marginal bone morphology with

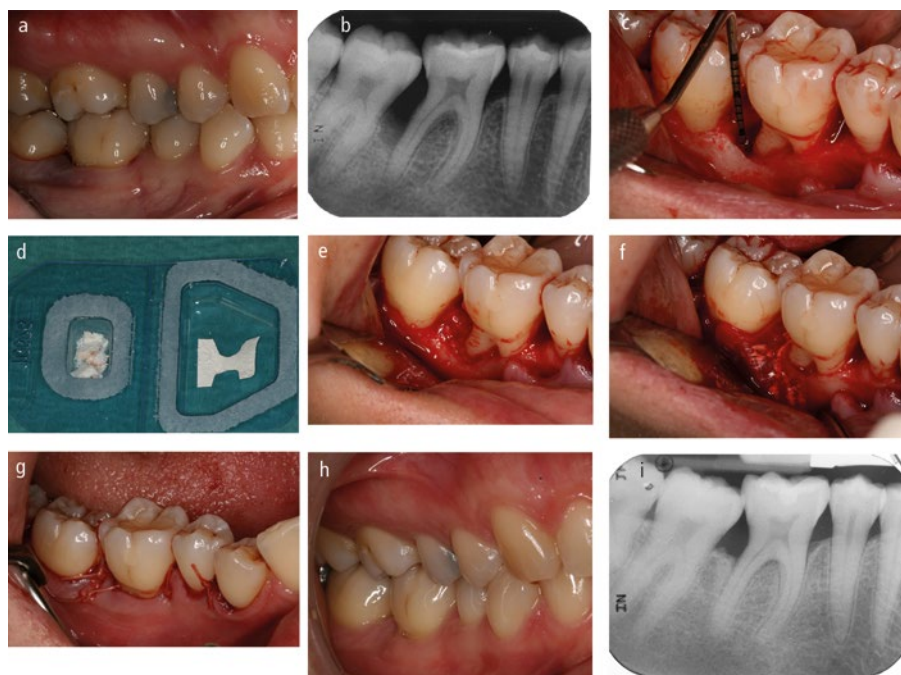


Fig. 4 44 distal intrabony defect treated with GTR. (A) Pre-operative photograph of 46; (B) Pre-operative radiograph of 46; (C) Bony defect of 5 mm depth visible following raising flap; (D) Deproteinised bovine bone matrix with porcine collagen and porcine membrane prepared for application; (E) Application of bone matrix product; (F) Porcine membrane applied over bone matrix product; (G) Flap closure; (H) 1-year review; (I) Radiograph at 3-year review



Fig. 5 44 distal intrabony defect treated with enamel matrix derivative, (A) Pre-operative radiograph showing intra-bony defect 44 distal; (B) Pre-operative photograph; (C) Simplified papilla preservation flap raised showing three-walled intra-bony defect; (D) Flap closure following administration of enamel matrix derivatives

a positive architecture; that is where the interproximal bone crest is coronal to the mid-buccal and mid-lingual bone crests around

a tooth.¹ This is to facilitate healing of the gingival tissue to achieve morphology that aids self-performed plaque control. Osteoplasty is

performed to enhance soft tissue placement and adaptation on wound closure, osteotomy is used to eliminate intrabony defects. Osteoplasty is usually directed at buccal and lingual bony ledges, shallow buccal or lingual intrabony defects, thick interproximal areas and incipient furcation involvements.³² Buccal and lingual bony ledges develop as the bone that resorbs coronally is thinner than the width of the bone around the root apically. As the coronal bone is lost, it leaves a wide shelf or ledge behind more apically. Indications for osseous resective surgery include:

- Excess gingival tissue
- Shallow intra-bony defects
- Bony craters
- Furcation involvement that is not amenable to regeneration
- Bony exostoses.

Intra-bony defects 3 mm or less in depth are usually treated via osseous resective surgery as the majority of regenerative surgery studies have been performed on defects of at least 4 mm depth with larger linear amounts of CAL gain in deep compared with shallow defects.³³ In terms of infra-bony defects, osseous recontouring involves removing (reducing) the walls of the defect to eliminate the bony defect. An example is shown in Figure 3. Alternatively, in cases where this may compromise periodontal support, a combination of recontouring and packing of locally harvested autogenous bone chips can be considered.

In probing depths averaging 7 mm, resultant 3 mm probing depths can be expected to be achieved 8 weeks post-operatively, with these increasing to 4 mm at 1 year and 5 mm at 5 years despite SPT.^{34,35,36} At 5 years the PPDs are similar to NSPT but they do not relapse to pre-surgical levels.^{34,37} This relates to the position of the soft tissues following resective surgery being dynamic over the long term and can be affected by underlying bone contours, tooth position, tooth anatomy, embrasure spaces, age and gingival biotype.³² The clinical benefit of resective surgery over access flaps is that it will result in more recession which will leave more of the tooth tissue exposed supra-gingivally, facilitating self-performed plaque control and SPT.³⁷

Residual PPDs on the distal of last-standing molars are often associated with significant thick mobile gingival tissue, poor access and bony protuberances, which lend themselves to correction by a type of resective surgery termed distal wedge surgery.³⁸ Other variations of classical resective surgery include a tunnelling

Fig. 6 Flow chart of treatment options for residual periodontal probing depths



procedure to open a furcation, root resection and hemisection. The main risk associated with tunnelling is the development of root caries.³⁹ Root resection can show a range of outcomes however; if performed well with good maintenance 10-year survival rates of 93% can be achieved.⁴⁰ Hemisection involves removal of half of a mandibular molar in terms of its root and crown. In addition to other more general factors, the decision to undertake tunnelling, root resection or hemisection will be dictated by the root divergence, shape, length, level of furcation, height of root trunk and residual bone support.

Guided tissue regeneration (GTR)

This is defined as procedures attempting to reproduce lost periodontal attachment through differential tissue responses.¹ The aim is to increase periodontal attachment, decrease pocket depth and avoid recession.⁴¹ Although technique sensitive, it has been shown to be effective in a range of intrabony defects, with two- and three-walled defects being more predictable due to their ability to maintain space for blood clot stabilisation and hard tissue infill.^{42,43} In addition, better outcomes compared with access flaps have been reported in class II furcation defects, where they are

usually converted to class I furcations, however poor outcomes are associated with class III furcations.^{44,45} Buccal furcations of both upper and lower molars show predictable outcomes, however this is not the case for interproximal furcations.

Factors affecting the outcome of regenerative procedures include patient factors, inappropriate surgical technique or material and insufficient clinical experience.⁴⁶ Deeper defects generally show greater clinical improvement and wider defects (an angle of more than 37 degrees between the bony wall and the tooth) show poorer outcomes.⁴¹

Defects with an angle less than 25 degrees show significantly improved outcomes.⁴⁷ Root canal treatment does not appear to impact on surgical outcomes.⁴⁸ Grade II to III mobile teeth show poorer outcomes.⁴¹

Accepting prerequisites of excellent oral hygiene, minimal inflammation and adequate keratinised gingivae, in addition to standard surgical requirements, indications for GTR include:

- Two- or three-walled space-maintaining intra-bony defects with a radiographic angle below 25 degrees
- Grade II furcation involvement.

GTR depends on the presence of space for blood clot formation and stability and primary closure to prevent bacterial contamination. A variety of materials and flap designs (similar to access flaps, see Fig. 2) are available for GTR with various outcomes reported in different scenarios. If case, material and surgical technique selection are good then excellent outcomes can be predictably achieved.⁴⁹ Examples are shown in Figure 4 and Figure 5.

A systematic review has shown that for every eight (95% confidence interval 7–33) patients treated, one will gain 2 mm or more attachment compared with access flap surgery.⁴² Probing depth reduction was also significantly higher at approximately 1.2 mm and the amount of recession reduced. Ninety-six percent of teeth have been shown to survive at average follow-up for 8 years; the teeth that were lost were all found to be in smokers.⁵⁰ Due to the enhanced clinical attachment gain, reduced recession and good long-term stability, GTR is generally accepted as a favourable option compared with access flaps and resective surgery where the anatomy allows.

Decision-making process

When faced with residual probing depths at reassessment the clinician must establish the cause. Once this has been established then consideration can be given to the best approach to deal with the cause and hence resolve the probing depth. For example, a PPD associated with a root groove is unlikely to respond favourably to further NSPT with adjunctive local antimicrobials whereas an access flap coupled with removal of the groove is more likely to achieve success. Development of this cognitive ability takes time, experience, reflection and guidance. The clinician should aim to develop a sieve of options for common

scenarios to work through in order to achieve the appropriate option. This may be in order of invasiveness, or in order of the likelihood of achieving the ideal outcome for that case. Patient preferences, for example corrective surgery compared with SPT, will influence decisions made. Once a plan is decided, further more detailed decisions will need to be taken, for example choice of materials for GTR or flap design for resective surgery. A flow chart to aid the decision-making process in the management of residual probing depths is shown in Figure 6. Inherently there are a number of different approaches to any one case and clinician experience will impact on the approach taken.

Summary

At reassessment of periodontitis, a systematic approach to gathering information should be undertaken to update the history and examination, targeted in a way to assess for potential causes of residual probing depths. Where these are present, they may be associated with a wide range of systemic and local factors or a combination of both. When the causative factors have been determined, treatment options appraisal can be effectively undertaken followed by further detailed planning and treatment provision. Methods to approach this process in a systematic fashion have been presented.

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