

Accelerating orthodontic tooth movement with the aid of periodontal surgery – the practitioner viewpoint

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Introduction: There has been a revival of interest in the acceleration of orthodontic tooth movement (OTM) by inducing injury to dentoalveolar cortical bone. Termed corticotomy, the procedure offers an advantage to adult patients whose bone metabolism is such that any reduction in treatment time would be welcomed. The procedure has been refined for over 100 years and recent research indicates treatment duration may be reduced often by as much as a third, but it is not clear how widely the method is applied in practice. For the procedure to be successful, careful interdisciplinary management by orthodontists and periodontists is required. However, information regarding the attitude and knowledge of practitioners and the frequency of the procedure performed in Australia and New Zealand is lacking.

Methods: A questionnaire was formulated and tested in a pilot study on postgraduate orthodontic and periodontic students at The University of Adelaide. As a consequence of the responses, the wording of several questions was clarified and the sequence modified to produce the final format. Separate questionnaires were developed for specialist orthodontists and periodontists in keeping with their different backgrounds and were distributed at two relevant conferences.

Results and conclusions: The number of practitioners who had been involved with at least one corticotomy per annum was low for orthodontists (12%) and periodontists (18%). The majority of those surveyed believed that more research was required on corticotomy-facilitated OTM and would not recommend the procedure to patients without greater investigation of the technique. More than half of the sampled orthodontists indicated that they would never recommend corticotomy-facilitated orthodontics to their patients. The minority who were willing to recommend the procedure would limit involvement to adult patients, the management of ankylosed teeth, impacted canines and patients susceptible to root resorption. Over 90% of the sampled periodontists believed that there were adverse side effects.

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Introduction

There is growing interest in the biological acceleration of the mechanisms behind orthodontic tooth movement (OTM). This is particularly relevant for adult patients whose orthodontic appliances may hinder social interaction and who, therefore, seek the quickest treatment possible. Upregulating bone turnover through selective surgery to enhance OTM involves a range of procedures – from an osteotomy, in which an invasive surgical cut is made through cortical and medullary bone, to corticision, which employs an interproximally-applied scalpel to injure

cortical bone without raising a soft tissue flap.¹

In 1959, Köle published a landmark paper entitled ‘Surgical operations on the alveolar ridge to correct occlusal abnormalities’, and described an osteotomy-like procedure that was less traumatic to the dental supporting structures.² The objective of this novel procedure, termed ‘corticotomy’, was to provide rapid movement of the teeth by weakening the cortical bone.

Despite studies describing the less invasive procedure, the dental community did not embrace its use.

Davidovitch and Murphy believed this was due to the 'naiveté of the early surgeons' who feared bone necrosis and periodontal pocket formation.³ It was 32 years after the initial publication of Köle's work that Suya finally revived academic interest in the surgery by showing 395 cases in which corticotomy-facilitated orthodontics had been performed.⁴

More recently, the Wilcko brothers published two case reports outlining a method of corticotomy-facilitated orthodontics with the addition of periodontal regenerative surgery.⁵ Their patented technique, referred to as Accelerated Osteogenic Orthodontics or Periodontally Accelerated Osteogenic Orthodontics, involved raising a full thickness soft tissue flap followed by selective buccal and lingual decortication. Vertical cuts were also made between the roots of the teeth just short of the alveolar crest. These cuts were connected beyond the tooth apices with a further scalloped horizontal cut. Round perforations in the cortical bone were made to enhance bleeding in the area and grafting material was employed when there were bony fenestrations or dehiscence.^{5,6}

A well-coordinated, interdisciplinary approach between orthodontists and periodontists was considered necessary for corticotomy-facilitated orthodontics to be successful.⁵ Even with growing evidence demonstrating the increased rate of tooth movement during the initial tooth alignment phase and its potential usage in selected cases, enthusiasm for the procedure was muted. Therefore, the aim of the present study was to identify similarities and differences in the awareness, knowledge, experience and desire for corticotomy-facilitated orthodontics between orthodontists and periodontists. Particular interest was paid to the level of cooperation between the two specialist groups, since significant teamwork is required to successfully provide the procedure.

Methods

A questionnaire was formulated from a pilot study conducted on postgraduate orthodontic and periodontic students at The University of Adelaide. The pilot study allowed the refinement of questions and the sequence in which they were asked to minimise ambiguity and optimise clarity. Expert opinion on questionnaire design was sought from the Australian Research Centre for Population Oral Health (ARCPOH).

Consequently, two separate questionnaires were developed, one for specialist periodontists and

the other for orthodontists (and the postgraduate students of the respective specialties), and distributed on two separate occasions. Each questionnaire was anonymous but respondents were asked for their year of graduation or prospective year of graduation if still a student and the University in which the specialist qualification was or would be attained. Respondents were also asked whether they were actively involved in teaching or research and, finally, information regarding their city and state of main practice was requested. Participation was voluntary and no financial incentives were provided.

The periodontal questionnaire was distributed by the primary investigator (BK) at the Australian and New Zealand Academy of Periodontists' 16th Scientific Conference (6-9th March 2013). The orthodontic questionnaire was distributed by the same investigator at the Australian Society of Orthodontists' Foundation Meeting (15-17th March 2013). The questionnaires were distributed at the beginning of a session and collected at the end.

Questions common to both groups included:

- *Have you heard about corticotomy-facilitated OTM or periodontally accelerated osteogenic orthodontics or Wilckodontics™?*
- *Where did you first hear about the procedure?*
- *For what reasons would you decide against undertaking the corticotomy procedure?*
- *What would make you feel more open to undertaking this procedure?*
- *Have you undertaken the treatment and if so how many cases in total have you undertaken?*

Questions specific to orthodontists included:

- *Would you recommend this procedure to any of your patients?*
- *If you were to recommend the procedure to patients, to what type of cases would you limit the corticotomy procedure?*
- *How important do you believe the reduction in treatment time is for patients?*
- *Are you using any other method to reduce the treatment time for your patients and if so please state the methods.*

Questions specific to periodontists included:

- *If an orthodontic colleague referred you a patient for the procedure described above, how comfortable*

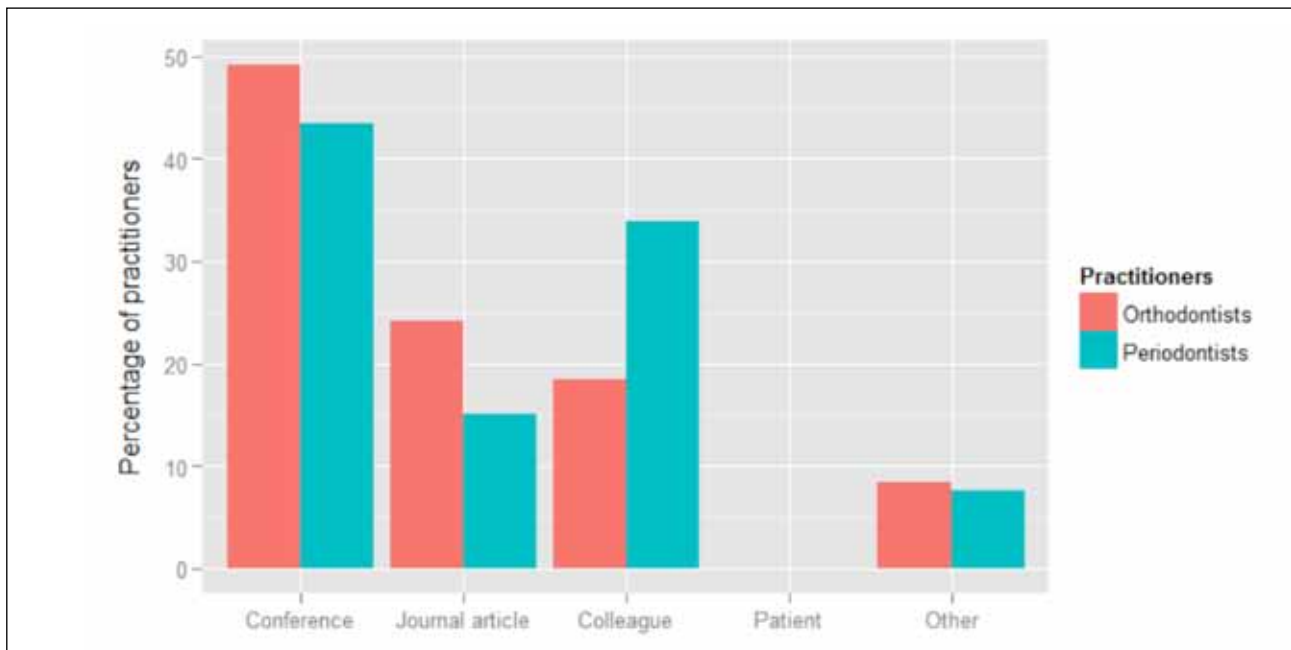


Figure 1. How did you first hear about the corticotomy procedure?

would you feel about carrying out the procedure?

Participants were asked to indicate their response on a visual analogue scale ranging from 0 to 10, with 0 being very uncomfortable and 10 being enthusiastic.

- *As a periodontist, do you believe that there are side effects to this procedure?*

The primary investigator coded the questionnaires, and the data were transferred manually into a spreadsheet. The accuracy of the data transcription was independently verified by a second person. Simple, descriptive statistics were calculated using Microsoft Excel.

Results

Of the 138 periodontists surveyed at the Australian and New Zealand Academy of Periodontists' Conference, 77 (56%) responded. Of the 257 orthodontists who registered at the Australian Society of Orthodontists' Foundation Meeting, 114 (44%) responded. The response rate was determined by the number of practitioners registered at the conference and not specific to those present at the session. Therefore, actual response rates might have been appreciably higher than calculated. Results have been organised according to (1) questions common to both groups; (2) questions specific to orthodontists; and (3) questions specific to periodontists.

Questions common to both groups

A greater number of orthodontists (96%) than periodontists (68%) had heard of the corticotomy procedure. The variation was statistically significant ($p < 0.0001$) according to Fisher's exact test. Excluding postgraduate students from the study yielded similar results: 97% of qualified orthodontists had heard of the procedure compared with 69% of periodontists. Focusing on orthodontists involved in teaching and/or research, 100% had heard about the procedure compared with 72% of periodontists, although when postgraduate students were excluded, 88% of teaching and/or research periodontists had heard about the procedure. Almost half of the orthodontists first encountered the procedure at a conference (49%), followed by journal articles (24%) (Figure 1). A slightly smaller number of periodontists first heard of corticotomy at a conference (44%), followed by colleagues (33%). No orthodontist or periodontist had heard of the corticotomy procedure via a patient.

A total of 74% of orthodontists deemed the corticotomy procedure to be too invasive, compared with 27% for periodontists (Figure 2). By contrast, 47% of orthodontists would not support the use of corticotomy because they did not know enough about the procedure, compared with 77% of periodontists. A similar number of orthodontists (61%) and periodontists (64%) believed that further research to address corticotomy-facilitated OTM would be

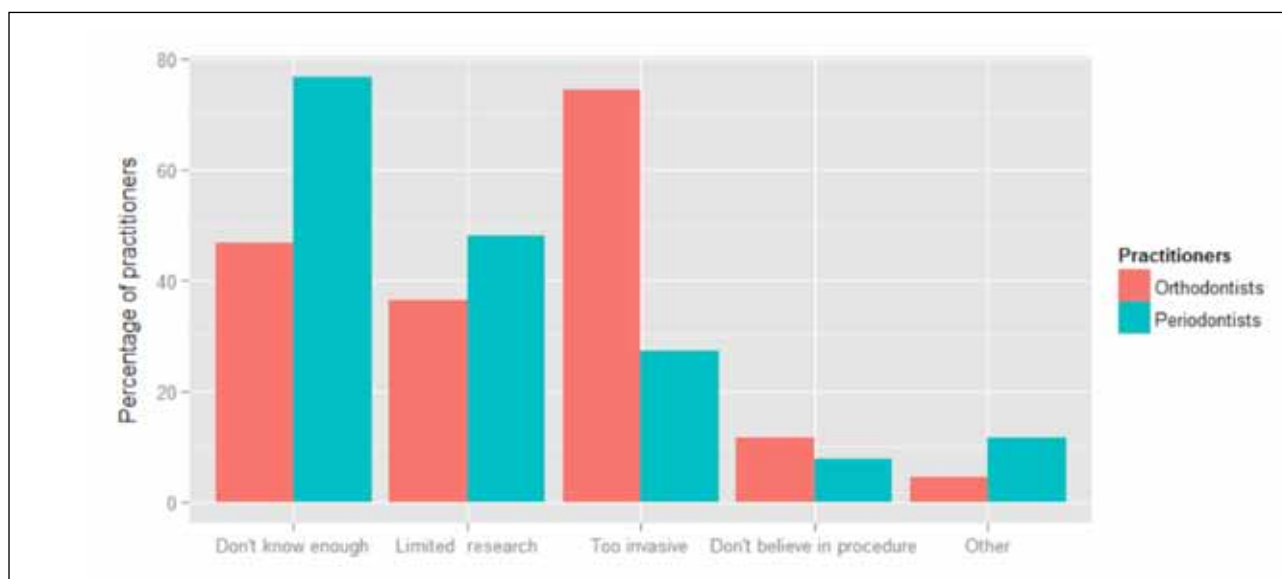


Figure 2. For what reasons would you decide not to recommend a corticotomy procedure?

important to feel comfortable in making a surgical recommendation to a patient. Only a small percentage of orthodontists (12%) and periodontists (18%) had experience with the corticotomy procedure, which suggested that the procedure and its application are still not widely applied.

Questions unique to orthodontists

Over half of the orthodontists (57%) indicated that they would not recommend the corticotomy procedure to their patients. Of those who were prepared to recommend the procedure, 30% would limit its application exclusively to adult patients, followed closely by managing an ankylosed tooth (28%). Secondary reasons included the treatment of an impacted canine (11%), patients susceptible to root resorption (6%) and other reasons (7%). Only 18% of orthodontists believed that a reduction in treatment time was 'not very important' for patients, while the remaining 82% stated it was important, very important or extremely important. Approximately 69% of orthodontists used other methods that are perceived to decrease treatment time, including Accedent, Suresmile, Damon, Insignia, indirect bonding and temporary anchorage devices.

Questions unique to periodontists

The mean value describing the level of comfort in performing a corticotomy procedure upon receiving

a referral from an orthodontic colleague was 3.11 on a scale of zero to ten, with zero being 'very uncomfortable', five being 'comfortable' and ten being 'enthusiastic'. The standard deviation was 2.69, and 75% of scores were less than five.

Discussion

The need for further research

The results of the survey indicated that orthodontists and periodontists were more likely to recommend a corticotomy procedure once further research is conducted and convincing evidence provided (61% orthodontists, 64% periodontists). Currently, periodontists felt uncomfortable undertaking a corticotomy procedure if a referral was made by an orthodontic colleague. Orthodontists were similarly uncomfortable in recommending the procedure, with 57% stating that they would not offer corticotomy-facilitated orthodontics to their patients. The remaining orthodontists would limit the corticotomy procedure to adult patients, ankylosed teeth, impacted canines, patients susceptible to root resorption and other circumstances, in that order. The number of practitioners who performed at least one case per annum was low, with only 12% of orthodontists and 18% of periodontists reporting corticotomy experience.

The literature regarding the procedure consists largely of case reports written by clinicians. However, the

number of scientific articles is increasing and an investigation in 2010 assessed the mechanism and morphological changes in the alveolar bone in response to corticotomy-facilitated OTM.⁷ The study used a rat model in conjunction with MicroCT, Faxitron analyses and molecular biology to determine that the early rapid movement observed in a corticotomy and tooth movement group was due to increased bone remodelling attributed to the surgical intervention. More specifically, the increase in OTM was due to a coupled mechanism of bone resorption and formation during the earlier stages of treatment.

As an alternative to randomised clinical trials that are often expensive, time consuming and difficult to design, a long-term evaluation of the effects on patients who have experienced the procedure may be more practical. A clear majority of the currently surveyed periodontists (91%) believed that corticotomy-facilitated orthodontics was associated with adverse side effects and emphasised their concerns regarding recession, devitalisation through root damage and bone loss.

Further investigation into the long-term effects of the bone grafting material that can be employed in the presence of fenestrations and dehiscences⁶ was also required. The constituents of grafting materials that have been used include:

- 100% demineralised freeze-dried bone allograft (DFDBA)
- a mixture of DFDBA and bovine bone
- a mixture of DFDBA and mineralised freeze-dried bone allograft.

Wilcko et al. showed a CBCT scan on a single patient in which a bone graft was stable after 2.5 years. However, in a second patient, bovine graft particles were found that had not been incorporated 8.5 months after the removal of fixed appliances.⁵

Improved interdisciplinary communication

The survey responses outlined above identified a number of differences of specialist opinion regarding corticotomy-facilitated orthodontics. A higher proportion of orthodontists stated that they were aware of corticotomy-facilitated orthodontics compared with periodontists. This is not surprising as the procedure largely benefits the orthodontic patient, and a referral is made by the orthodontist to

the periodontist for the surgical aspect of treatment. A conflict identified in the present study was that, if a referral was made from an orthodontic colleague, periodontists would feel uncomfortable performing the surgical procedure, due largely to the perceived lack of related knowledge and/or research.

If corticotomy-facilitated orthodontics is offered to selected patients, orthodontists and periodontists need to hold similar attitudes towards the procedure. This can be achieved through improved communication encompassing joint research, complimentary continuing education, discussion/debate at conferences and study groups. Educational momentum has already been gained by the Wilcko brothers presenting their Periodontally Accelerated Osteogenic Orthodontics (or Wilckodontics) course for both specialist groups. The possibility of future collaboration between the specialist groups may help determine how this procedure can be applied for the benefit of patients.

Are we ready to recommend corticotomy-facilitated orthodontics to patients?

The majority of orthodontic (88%) and periodontic (82%) respondents in the current study had not been involved in a case involving corticotomy. This suggested that most practitioners were not ready to recommend corticotomy-facilitated orthodontics to patients. Despite the lack of enthusiasm, 82% of orthodontists believed that a reduction in treatment time was important for patients. It was also revealing that almost a third of the orthodontists surveyed used alternative methods for reducing the duration of treatment, with the most common method being the AcceleDent device (14 respondents). Other appliance methods included Suresmile, Damon, Insignia, indirect bonding and temporary anchorage devices. In thoughtful replies, 'good treatment goals' and 'efficient mechanics' were also stated as optional methods to reduce orthodontic treatment time.

Due to its non-invasive nature, AcceleDent and other appliance-driven methods of reducing treatment time may be more appealing to clinicians compared with corticotomy-facilitated orthodontics and its accompanying and inherent surgical risks. However, if the duration of treatment is a critical factor for a patient, perhaps a corticotomy procedure could be discussed as an adjunctive service along with other possible methods. This may be analogous

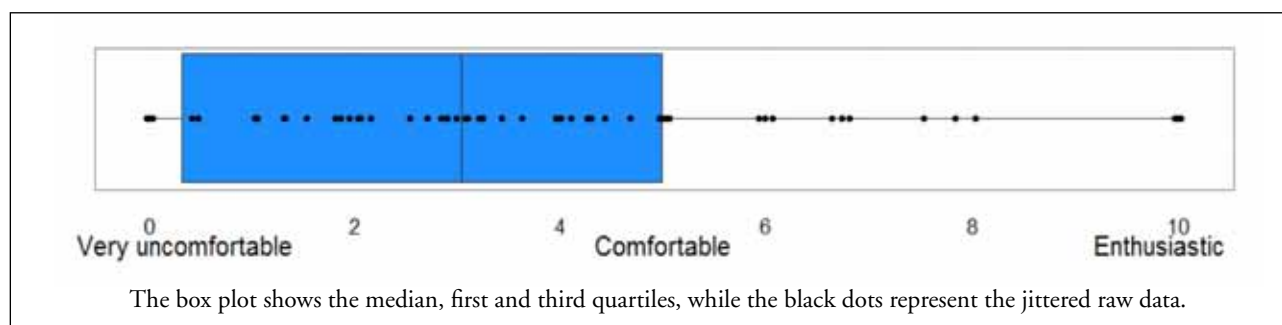


Figure 3. Likert distributions of how comfortable periodontists are in performing a corticotomy procedure.

to other invasive options such as orthognathic surgery, distraction osteogenesis and the exposure of unerupted teeth, all of which carry surgical risks. Some practitioners have already adopted this approach, judging from the small percentage who have had experience with corticotomy in the past.

Less invasive options for consideration

Researchers are investigating less invasive methods such as corticision and piezopuncture to optimise a regional acceleratory phenomenon. Corticision is an alternative method of injuring cortical bone without raising a muco-periosteal flap. A reinforced scalpel is used in conjunction with a mallet to incise the interproximal cortices transmucosally. In animal studies, the mean apposition area of new bone when orthodontic force was applied following corticision showed a 3.5-fold increase when compared with the use of orthodontic force alone.⁹

As an alternative to corticision, Dibart et al. published a case report outlining the use of a piezotome in order to evoke the RAP effect as the use of a mallet during corticision was considered 'somewhat aggressive'.¹⁰ Furthermore, unlike corticision, bone-grafting material could be added in selected areas by manipulating the vertical incisions in the gingiva without raising a full thickness flap.

A recent report of 'piezopuncture' in which a piezotome was used to make cortical punctures penetrating the gingiva around a moving tooth has revealed promising results in accelerating OTM in a dog model.⁸ There are numerous advantages compared with conventional osteotomies, including the selective cutting of mineralised tissues without damaging surrounding soft tissues and nerves, which remains a concern for most practitioners. Providing RAP and, therefore, the rapid movement of teeth as well as a

decreased potential for side effects, piezopuncture and its derivatives may be able to provide a reduction in treatment time by exploiting the underlying biological mechanism of bone.

The request for shorter treatment time will inevitably become a recurring demand by adult patients. Companies are already marketing hand-held devices, such as the Propel system, which harness the RAP effect by making punctures of predetermined depth into the cortical bone.¹¹ Given the interdisciplinary nature of the problem, orthodontists and periodontists need to work together to find efficient evidence-based ways of accelerating OTM with minimal side effects.

Conclusions

- A majority of surveyed orthodontists and periodontists believed more research was required on the topic of corticotomy-facilitated OTM before recommending the procedure to patients.
- More than half of the surveyed orthodontists would not recommend corticotomy-facilitated orthodontics to their patients.
- The minority who might recommend the procedure would limit it to adult patients, to ankylosed teeth, impacted canines and patients susceptible to root resorption.
- Over 90% of surveyed periodontists believed that there were adverse side effects associated with the corticotomy procedure.
- The number of surveyed practitioners who had been involved with at least one case per annum requiring a corticotomy procedure was low, as few orthodontists (12%) and periodontists (18%) reported direct experience.

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