ABSTRACT
This mini review is based on a Cochrane systematic review entitled ‘Interventions for replacing missing teeth: management of soft tissues for dental implants’ published in The Cochrane Library.

Clinicians are under pressure to meet patients’ expectations to provide them with naturally looking teeth, and while dental implants are very predictable nowadays, the challenge has shifted to the peri-implant soft tissue level, shape, thickness and contour. Many soft tissue manipulation techniques including flap designs and placing dental implants flapless have been promoted by different clinicians, each group of them defending their technique and/or approach. On the other hand, clinicians’ area subjected to information overload, and evidence based answers are needed when ever they are faced with a clinical intervention question at their daily practice, rather than relying on opinion based information. This mini review aims to answer two main questions: 1 Is flap elevation necessary in implant dentistry? 2 What is the best flap design in implant dentistry? Relying on up-to-date random controlled trials.

KEYWORDS
Flapless, Flap design, Soft tissue management.

INTRODUCTION
Traditionally, dental implant surgery starts with raising flap procedures for implant placement. However, in recent years there has been some interest in developing techniques that can provide function, advanced aesthetics, comfort and long lasting prognosis with as minimally invasive surgery as possible. To fulfil these requirements flapless surgery has been advocated by many clinicians. In return many flap design variations have strong proponents with surgeons claiming that a particular design offers improved implant success. However, there is frequently disagreement and this area is controversial.

Numerous techniques have been proposed to design flaps aiming to preserve or rebuild the interdental papillae, but it is still unclear which ones achieve the best results. This interesting subject is as important as the debate on various flap designs while placing dental implants.

HISTORY OF DENTAL IMPLANTS
Dental implants started to be offered as an option to replace missing teeth in the mid-1960s, however, implants were being used in very small numbers. Typical designs were sub-periosteal frames, blade vents or trans-mandibular devices, none of which was properly documented clinically. In general, only poor clinical results had been recorded even though allegedly successful cases were occasionally presented at meetings by the few academic outcasts who used the devices. Per-Ingvar Brånemark placed his first clinical root form dental implant in 1965.¹ In the following 5 years, his clinical results were also unacceptably poor, with success rates of about 50%. Brånemark’s early results seemed to confirm that foreign materials did not work in the oral cavity for a number of reasons including the risk of infection.²

During the 1970s clinical outcomes for patients with Brånemark’s implants have clearly improved, not as a result of traditional controlled trial studies but in an empirical way with the simultaneous changing of a great number of parameters. Implants were made wider with some design changes, implant healing time was prolonged and changes were made to the surgical and prosthodontic routines. Brånemark published an experimental study which mentioned the term osseointegration,¹ but it was till the late 1970s when he published a retrospective clinical study which further discussed and confirmed the concept of osseointegration of dental implants , which was described as direct structural and functional connection between living bone and implant surface.³

Since that time, the revolutionary concept of osseointegration is now considered highly predictable. Today the implant-supported dental restorations are among the most accepted treatment options for treating edentulous and partially edentulous patients.

Flap Design
The term ‘flap’ been used to indicate a section of soft tissue that is outlined by a surgical incision, carries its own blood supply, allows surgical access to underlying tissues, can be replaced as required on its original position, maintained with sutures and is expected to heal.⁴
Implants are usually placed after soft tissue flap elevation to visualize better the bone sites where the implant(s) will be placed. Flap elevation ensures that some anatomical landmarks (e.g. foramina, lingual undercuts or maxillary sinuses) are clearly identified and protected. When the amount of available bone is limited, flap elevation will facilitate implant placement maximizing bony contact while minimizing the risk of bone fenestrations. However, flaps are associated with some degree of morbidity and discomfort, and require suturing. There are situations, where flap elevation may not be necessary since the amount of bone is more than adequate and the risk of complications is minimal. Under these circumstances, flapless implant placement may be indicated, but when placing implants with a flapless procedure the surgeon is working blindly and care must be taken to avoid any complications such as bone perforations. Guided surgery aided with customized surgical templates derived from CT scans can help clinicians to minimize the risk of perforation and incorrect implant alignment.

When dental implants are placed after reflecting soft tissue flaps, there generally is some bone resorption. During the initial phase of healing, bone resorption of varying degrees almost always occurs in the crestal area of the alveolar bone. The extent of alveolar height reduction resulting from this resorption is related to the bone thickness at each specific site.

When teeth are present, blood supply to the bone comes from three different sources: from the connective tissue above the periosteum, from the periodontal ligament, and from inside the bone. When a tooth is lost, blood supply from the periodontal ligament disappears, so that blood now only comes from soft tissue source through the connective tissue above the periosteum and from the bone. Cortical bone is poorly vascularised and has very few blood vessels running through it, in contrast to soft cancellous bone. When soft tissue flaps are reflected for implant placement, this will disturb the periosteal layer; hence, the blood supply from the soft tissue to the bone (supra-periosteal blood supply) is removed, thus leaving poorly vascularised cortical bone without a considerable part of its vascular supply, prompting bone resorption during the initial healing phase. Another major function of the periosteum which will be badly affected is the venous blood drainage, therefore after raising a surgical flap and disturbing the periosteum, the amount of resulting post operative oedema is usually considerable due to lack of proper drainage.

There is some swelling, pain, and discomfort associated with every surgical procedure. With a flapless approach, surgical trauma is minimal because the punch or circular cut is very small, usually 1 mm wider than the implant to be placed, so that postoperative pain, swelling, and discomfort related to soft tissue trauma are greatly minimized.

There are many advantages for the patient as well as for the surgeon, since the procedure is less time consuming, bleeding is minimal, implant placement is expedited, and there is no need to place and remove sutures. However, since flapless implant placement generally is a “blind” surgical technique, care must be taken when placing implants. Angulation of the implants affected by drilling is critical so as to avoid perforation of the cortical plates, both lingual and buccal, especially on the lingual side of...
was sutured back in place. The rationale for this incision was to keep the incision line away from the implants, thereby possibly preventing infection.

In a retrospective study, it has been demonstrated that there was no difference in the implant success rates when implants were placed with a mid-crestal incision, however, they concluded that it was far more advantageous to use a mid-crestal incision since the swelling and the postoperative pain were greatly minimized.

THE EVIDENCE
Is flap elevation necessary?
Lindeboom et al. in their random controlled trial compared flapless versus flap elevation to place at least 6 implants in fully edentulous maxillae. The flapless surgery procedure was performed using individually customised surgical templates fabricated with CAD/CAM technology planned with the Procera Software 3D Planning Program (Nobel Biocare AB, Goteborg, Sweden). In the flapless group, soft tissues were punched away and after implant installation, the punch wounds were sutured. Data were reported in the publication up to 1 month after implant placement, however, the authors provided data up to 6 months after loading. At baseline, the patients who were going to receive flapless surgery were less satisfied. There were no withdrawals or complications up to 6 months. Two implants were lost in the flapless group versus none in the flap elevation group but this difference was not statistically significant.

In another random controlled trial on flapless dental implant, Fortin et al. compared a flapless versus a conventional flap elevation procedure to place dental implants in partially or fully edentulous patients in a randomised controlled trial. The flapless surgery procedure was performed using an image-guided system (CAD Implant, Medfield, Ma, USA) based on a template. After a 6 day follow up, thirty patients were included in each group and it was reported that less patients subjected to the minimally invasive surgery experienced postoperative pain than those patients subjected to conventional flap elevation.

Cannizzaro et al., and compared a flapless versus a conventional flap elevation procedure to place dental implants in partially edentulous patients. Templates were used for both groups. The flapless surgery procedure was performed based on intra oral, panoramic or CT scan information. Implants that obtained a primary stability >45 Ncm (all but one) were functionally loaded the same day. Implants in the control group were placed after mid-crestal incision and flap elevation following the manufacturer instructions. Twenty patients were included in each group with no apparent baseline differences between the two groups. No withdrawals after 3 years. In one patient of the flapless group, a flap had to be elevated to properly evaluate the direction of the drill. No prosthesis or implant failed.

the mandibular anterior area. In a 10 year retrospective review, a 3% fenestration of the implants placed flapless was reported due to incorrect bur angulation. However, there should be no problem if the patient has been appropriately selected and an appropriate width of bone is available for implant placement.

From all the above, we can tell that whether to raise a flap or not while placing dental implants is a very controversial subject, and this is going to be the first question in our systematic review.

In connection to the above subject, another question which clinicians face is what the best flap design is. The surgical placement of dental implants has undergone changes since the beginning of placement of root-form implants. Initially, using the Brånemark protocol, an incision in the mucosa or the muco-buccal fold was made, and then a flap was reflected to expose the underlying bone. The implants were placed and the flap was sutured back in place. The rationale for this incision was to keep the incision line away from the implants, thereby possibly preventing infection.

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Five patients had complications in each group: transient disturbance of the alveolar inferior nerve (one patient), maxillary sinus membrane perforation (one patient), peri-implant mucositis (one patient) and perimplantitis (two patients) in the flapless group; and wound dehiscence (two patients), peri-implant mucositis (one patient) and perimplantitis (two patients) in the conventional flap group. Less patients subjected to a flapless procedure experienced postoperative pain than those patients subjected to conventional flap elevation. Canizzaro et al. reported that patients of the flapless group suffered significant less oedema and consumed less analgesics than those in the conventional flap group.

Cannizzaro et al.13 in a more recent study, compared flapless versus flap elevation implant placement in partially edentulous patients following a split-mouth design random controlled trial. All implants were placed with an insertion torque >48Ncm and were immediately functionally loaded. Forty patients were included and two prostheses and two implants failed in each group, all in different patients. Once more, there were no statistically significant differences for prosthesis/implant failures or biological complications between the two groups. However, it is worth mentioning that one patient had one biological complication (peri-implantitis with purulent discharge) in the flapless group versus four complications in three patients (one intrasurgical haemorrhage, one intrasurgical fracture of the buccal bone plate, one case of peri-implant marginal bone loss exceeding 4mm and one patient experiencing pain on chewing) in the flap elevation group. Fewer patients subjected to a flapless procedure experienced postoperative pain than those subjected to flap elevation. An interesting finding was that there were no differences for peri-implant marginal bone levels between the flapless and the conventional flap groups. Thirty-one patients preferred the flapless intervention; three patients preferred flap elevation and six patients had no preference. This difference was statistically significant. In this study, it was also reported that patients of the flapless group suffered significantly less postoperative swelling and consumed less analgesics than those in the flap elevation group and that the flapless procedure was significantly shorter.

In a recent systematic review, Esposito et al.14 reported that there is limited weak evidence suggesting that flapless implant placement can cause less postoperative pain, oedema and consumption of analgesics than flap elevation. Flapless surgery performed by skilful clinicians in properly selected cases can be as successful and complication-free as conventional flap elevation. Further more, it was recommended that clinicians should select patients for flapless implant placement with a great deal of caution with respect to their own clinical skills and experience. One interesting finding at the same systematic review was that the safety and efficacy of customised surgical templates created with the help of planning software on CT scans to facilitate flapless placement of dental implants still needs to be assessed, especially for fully edentulous patients where it might be more difficult to correctly position the stent.

Which is the most effective flap design/technique?
A randomised controlled trial by Hunt et al. in 199615 compared the vestibular incision with the crestal incision using a split-mouth design of fully and partially edentulous patients. Patients were examined at 1, 7, 14 and 30 days, as well as at abutment connection 4 to 6 months after. The authors reported no significant differences for pain and oedema. Furthermore, there were no statistically significant differences for biological complications (wound dehiscence) which occurred in two sites of the crestal and three sites of the vestibular incision. In another random controlled study, Heydenrijk et al.16 compared crestal versus vestibular incisions to place one-stage dental implants with five patients were included in each group. There were no statistically significant differences for prosthesis/implant failures and complications between the groups. However, it was reported that four patients from the crestal group and one from the vestibular group suffered from hyperplastic tissue covering the healing abutment after surgery.

Arnabat-Domínguez17 compared Erbium: YAG laser with flap elevation at implant exposure to connect abutments. Ten patients were included in each group, once more, no withdrawal or implant failures occurred up to 6 months after abutment connection. Patients treated with laser did not receive local anaesthesia, though two patients had to be anaesthetised during the procedure: one due to pain and one due to profuse bleeding (complication). Fewer patients treated with laser experienced postoperative pain than those treated with conventional flap elevation. In the article, it was also reported that patients of the laser group consumed significantly fewer analgesics and more interestingly, the prosthesis procedures could start earlier (after 7.3 days) than in patients of the conventional flap group (after 13.6 days).

CONCLUSION
There is evidence suggesting that flapless or minimvasive procedures can cause less postoperative pain, oedema and consumption of analgesics than conventional flap elevation. Flapless surgery performed by skilful clinicians in properly selected cases can be as successful and complication-free as conventional flap elevation. However, there is still insufficient evidence regarding a potential increased risk of complications/failures using a flapless approach. Clinicians should select patients for flapless implant placement with a great deal of caution in relation to their own clinical skills and experience. The safety and efficacy of customized surgical templates created with the help of planning software on CT scans to facilitate placement of dental implants needs still to be assessed.
Very little well conducted studies were found on the best flap design for implant dentistry, although it is a major issue for every implant dentist, since the high number of complications may have occurred simply by chance. It would be prudent not to extrapolate any conclusions from any short term studies with few number of patients, not to mention case reports as larger random controlled multicentre trials are needed to answer this question. More research (properly designed and conducted randomised controlled trials) is needed to evaluate the potential risks/advantages of flapless procedures and the safety and efficacy of implant planning software based on CT scans.

REFERENCES


