Review

Dental implants in the medically compromised patient

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ABSTRACT

Objective: It has been suggested that some local and systemic factors could be contraindications to dental implant treatment. The objective of this paper was to evaluate whether success and survival rates of dental implants are reduced in the medically compromised patient.

Data/sources: An extensive literature search was conducted using PubMed/medline, Scopus, Scirus and Cochrane databases up to November 8, 2012.

Conclusions: There are very few absolute medical contraindications to dental implant treatment, although a number of conditions may increase the risk of treatment failure or complications. The degree of systemic disease-control may be far more important that the nature of the disorder itself, and individualized medical control should be established prior to implant therapy, since in many of these patients the quality of life and functional benefits from dental implants may outweigh any risks.

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1. Introduction

In medically healthy patients, the success rates of some dental implant (DI) systems have reported to be between 90 and 95% at 10 years.1 DI may fail, however, due to a lack of osseointegration during early healing, or when in function due to breakage, or infection of the peri-implant tissues leading to loss of implant support. Early complications after implant installation, can include pain, infection or occasionally neuropathy.1 Severe early complications such as haemorrhage (e.g. in the floor of the mouth) or descending necrotizing mediastinitis are rare.2–6

The longer term outcome of implant therapy can be affected by local or systemic diseases or other compromising factors, in fact, it has been suggested that some local and systemic factors could represent contraindications to DI treatment.7–10

2. Dental implants in medically compromised patients

The impact of health risks on the outcome of implant therapy is unclear, since there are few if any randomized controlled trials (RCTs) evaluating health status as a risk indicator. In
principle, only patients with an ASA (American Society of Anæsthesiologists) grade I or II should qualify for an elective surgical procedure, such as DI placement and the patient’s surgical risks should be weighed against the potential benefits offered by the DI.11

Even though there are statements in the implant literature such as: “certain conditions such as uncontrolled diabetes, bleeding disorders, a weakened immune system, or cognitive problems that interfere with postoperative care increase the risk of implant failure” (http://www.dentalphobia.com/isd-procedures_implants.htm) these are un-substantiated by scientific evidence.

Other authors have recommended as relative contraindications for DI, certain patient groups or conditions7:

- Children & adolescents
- Epileptic patients
- Severe bleeding tendency
- Endocarditis risk
- Osteoradionecrosis risk
- Myocardial infarction risk

Other reported relative contraindications include: adolescence, ageing, osteoporosis, smoking, diabetes, positive interleukin-1 genotype, human immunodeficiency virus positivity, cardiovascular disease, hypothyroidism and Crohn disease.8,9

Suggested absolute contraindications include: recent myocardial infarction and cerebrovascular accident, transplant or valvular prosthesis surgery, profound immunosuppression, severe bleeding issues, active treatment of malignancy, drug abuse, psychiatric illness, as well as intravenous bisphosphonate use10 but there is, however, little or no evidence to support most of these contentions.

It is, therefore, the aim of this review to evaluate the scientific evidence through PubMed/Medline, Scopus, Scirus and Cochrane databases searches up to November 8, 2012, using as keywords: implants, contraindications, and the following disease categories, which had been highlighted as possible contraindications in more than one publication12,13:

- Alcoholism
- Bleeding disorders
- Bone disease
- Cancer patients
- Cardiac disease
- Corticosteroids
- Diabetes
- Hyposalivation
- Immuno-compromised patients
- Mucosal disease
- Neuro-psychiatric disorders
- Titanium allergy

This evidence has been drawn from a wide range of sources, ranging from case reports to controlled cohort investigations, including both human and animal studies. Implant outcome assessment has varied from histological and radiographic outcomes, to objective and subjective determinations of implant and treatment failure. The aim of this study was to evaluate the level of evidence of the available literature on contraindications to DI therapy in medically compromised patients. Contraindications are mainly based on both the risk of medical complications related to implant surgery (e.g. haemorrhage risk in patients with bleeding disorders) and the rate of DI success in medically compromised patients (e.g. in patients with head and neck cancer receiving radiotherapy). This review, hence, summarizes this evidence applying recognized evidence-based criteria.14

3. Alcoholism

We could not identify any reliable evidence indicating that alcoholism might be a contraindication to DI. Negative effects of alcohol intake on bone density and osseointegration in animal models, however, have been demonstrated.15,16 In humans, there is evidence of increased peri-implant marginal bone loss and DI failures in patients with high levels of alcohol consumption.17,18 In general terms, however, it is worth considering before implants are placed that alcoholism:

- is often associated with tobacco smoking,
- may via liver disease, cause bleeding problems,
- may cause osteoporosis,
- may impair the immune response,
- may impair nutrition, especially folate and B vitamins.

In summary, although there is no evidence that alcoholism is a contraindication to implants, these patients may be at increased risk of complications (Table 1).

4. Bleeding disorders

Even though haemorrhage can be a relatively common complication in DI placement,19 there is no reliable evidence to suggest that bleeding disorders are a contraindication to the placement of implants: even haemophiliacs have successfully been treated with DI.20 Nevertheless, any oral surgical procedure may lead to haemorrhage and blood loss and, if this bleeding reaches the fascial spaces of the neck, it can hazard the airway. In fact, upper airway obstruction secondary to severe bleeding in the floor of the mouth is a rare but potentially life-threatening complication of DI placement.4 Usually arterial impingement is produced when perforating the lingual cortical plate affecting the lingual arteries or the inferior alveolar canal, affecting the inferior alveolar vessels.5 DI placed in the first mandibular premolar position are the higher risk for this bleeding complication.21

In patients with bleeding disorders, haemorrhage associated with implant surgeries is more common and can be prolonged,22 particularly with warfarin or acenocoumarol. In these patients, the current recommendation is to undertake the implant surgical procedure without modifying the anticoagulation, provided the INR is less than 3 or 3.5.22 In this context, implant surgery could be regarded in terms of surgical trauma to the extraction of three teeth. There is evidence that anticoagulated patients (INR 2–4) without discontinuing the anticoagulant medication do not have a significantly higher risk of post-operative bleeding and, topical haemostatic agents are
<table>
<thead>
<tr>
<th>Condition</th>
<th>Evidence condition is an absolute/relative contraindication to DI</th>
<th>DI success rate compared to healthy population (level of evidence^a)</th>
<th>Other considerations</th>
<th>Management modifications that may be indicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoholism</td>
<td>–</td>
<td>Similar (5)</td>
<td>Tobacco use</td>
<td>These patients may be at increased risk of complications</td>
</tr>
<tr>
<td>Bleeding disorder</td>
<td>Medical advice should be taken first in congenital bleeding disorders</td>
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<td></td>
<td>These patients may be at increased risk of complications</td>
</tr>
<tr>
<td>Bone disease</td>
<td>–</td>
<td>Similar (4)</td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>–</td>
<td>Similar (4)</td>
<td>Peri-implantitis and marginal bone resorption increase with concomitant connective tissue diseases</td>
<td>Sinus lifts may be contraindicated</td>
</tr>
<tr>
<td>Osteoporosis</td>
<td>–</td>
<td>Similar (2a)</td>
<td></td>
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<tr>
<td>Osteoporosis and oral bisphosphonates</td>
<td>–</td>
<td>Similar (1b)</td>
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<td>–</td>
</tr>
<tr>
<td>Cancer and intravenous bisphosphonates</td>
<td>Contraindicated (5)</td>
<td>Reduced (4)</td>
<td></td>
<td>–</td>
</tr>
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<td>Head &amp; neck cancer patients</td>
<td>–</td>
<td>Reduced (1b) (following radiotherapy)</td>
<td>Cancer prognosis</td>
<td>Surgery best carried out 21 days before radiotherapy Hyperbaric oxygen should be given if &gt;50 Gy used (controversial) Defer DI for 9 months Consider antimicrobial cover Use chlorhexidine Antibiotic prophylaxis</td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>Medical advice should be taken first</td>
<td>Similar (5)</td>
<td>May be anticoagulated</td>
<td>Avoid general anaesthesia Consider endocarditis prophylaxis Corticosteroid cover</td>
</tr>
<tr>
<td>Corticosteroid therapy</td>
<td>–</td>
<td>Similar (5)</td>
<td>Poor risk for general anaesthesia May be impaired immunity</td>
<td>Corticosteroid cover</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>–</td>
<td>Slightly reduced in bad metabolic control patients (2a)</td>
<td>Microvascular disease</td>
<td>Antibiotic prophylaxis HbA1c level for patient selection Avoid hypoglycaemia Use chlorhexidine</td>
</tr>
<tr>
<td>Hyposalivation</td>
<td>–</td>
<td>Similar in good metabolic control patients (2b)</td>
<td>Osteoporosis</td>
<td>Use chlorhexidine</td>
</tr>
<tr>
<td>Immunocompromised patients</td>
<td>Medical advice should be taken first</td>
<td>Similar in organ transplantation patients (4)</td>
<td>Impaired immunity</td>
<td>Antibiotic prophylaxis</td>
</tr>
<tr>
<td>Mucosal disease</td>
<td>–</td>
<td>Similar (4)</td>
<td>Behavioural</td>
<td>Consider general anaesthesia</td>
</tr>
<tr>
<td>Neuropsychiatric disorders</td>
<td>Medical advice should be taken first</td>
<td>Similar (4)</td>
<td></td>
<td>–</td>
</tr>
</tbody>
</table>
effective in preventing post-operative bleeding.\textsuperscript{23} Oral anticoagulant discontinuation is thus not recommended for dental-veolar surgery, such as implant placement, provided that this does not involve autogenous bone grafts, extensive flaps or ostectomy preparations extending outside the bony envelope. In a recently published case series involving 50 consecutive patients receiving oral anticoagulant therapy (warfarin) without interruption or modifications to their therapy, it was shown that a standard protocol of local haemostasis in dental implant surgery is able to prevent bleeding complications in patients on oral anticoagulants, allowing these surgical procedures to be performed on an outpatient basis.\textsuperscript{24}

The bleeding risk is also low in patients treated with heparin.\textsuperscript{25} In patients on single or dual antiplatelet therapy, the frequency of oral bleeding complications after invasive dental procedures is low to negligible and, therefore, the risks of altering or discontinuing use of the antiplatelet medications – increased risk of thromboembolism – far outweigh the low risk of haemorrhage.\textsuperscript{26}

In summary, there is no evidence that any bleeding disorders are an absolute contraindication to DI surgery, although these patients may be at risk of prolonged haemorrhage and blood loss, and medical advice should be taken first especially in congenital bleeding disorders (Table 1).

### 5. Bone diseases

There are few reported cases in the literature of DI placement and subsequent rehabilitation of patients with these bone diseases such as osteogenesis imperfecta,\textsuperscript{27–22} polyarthritis,\textsuperscript{33} or ankylosing spondylitis,\textsuperscript{34} and to our knowledge no relevant case series have been published up to date. On the contrary, at least two retrospective series on dental implants outcomes involving 34 and 22 females suffering from autoimmune rheumatoid arthritis with or without concomitant connective tissue diseases have been published, the authors concluding that a high implant and prosthetic success rate can be anticipated in rheumatoid arthritis patients, but peri-implant marginal bone resorption and bleeding are more pronounced in those with concomitant connective tissue diseases.\textsuperscript{35,36}

In summary, a number of bone disorders may potentially influence the outcome of DI, but few studies have evaluated scientifically this risk (i.e. DI in patients with rheumatoid arthritis),\textsuperscript{35} being most of the published investigations related to the relationship between bone density and implant success.

Osteoporosis is the most studied bone-related disease. It is a common condition characterized by generalized reduction in bone mass with no other bone abnormality. When evaluating whether DI in osteoporotic patients have a different long-term outcome, even though failure rates have been reported higher in animal models\textsuperscript{37} and patients,\textsuperscript{38,39} a systematic review revealed no association between systemic bone mineral density (BMD) status, mandibular BMD status, bone quality, and implant loss, concluding that the use of DI in osteoporosis patients is not contraindicated.\textsuperscript{40} In a cross-sectional study no relation was found between osteoporosis and peri-implantitis\textsuperscript{41} and even patients with severe osteoporosis have been successfully rehabilitated with DI-supported prostheses.\textsuperscript{42,33} There are, however, some case-control studies reporting a weak association between osteoporosis and the risk of implant failure\textsuperscript{43} and some authors have alluded to a correlation between BMD of the mandible with BMD measurements at other skeletal sites.\textsuperscript{44} It is, therefore, recommended to thoroughly evaluate the jawbone quality prior implant placement, rather than undertaking systemic BMD and osteoporotic status assays.\textsuperscript{45,45} Dentists should perform an accurate analysis of bone quality by means of tomography and modify treatment planning if indicated (e.g. using larger implant diameter and with surface treatment).\textsuperscript{46}

A further potential complication in osteoporotic patients is the possible effect on bone turnover at the DI interface of systemic anti-resorptive medication. This risk in patients using bisphosphonates (BPs) is well recognized,\textsuperscript{47} in terms of bisphosphonate-related osteonecrosis of the jaws (BRONJ).\textsuperscript{48–50} The largest series of patients developing BRONJ following DI published to date involved 27 patients on BPs, 11 orally and 16 intravenously. BRONJ developed after mean periods of 68 months, 16 months, and 50 months in patients on alendronate, zoledronic acid, and pamidronate, respectively. There was a mean duration of 16 months from implants placement until the appearance of BRONJ.\textsuperscript{51} Recently, in a series of BRONJ following DI involving 14 patients on BPs, 5 orally and 9 intravenously, it has been suggested that posteriorly placed implants seem to be of higher risk of BRONJ development.\textsuperscript{52}

<table>
<thead>
<tr>
<th>Condition</th>
<th>Evidence condition is an absolute/relative contraindication to DI</th>
<th>DI success rate compared to healthy population (level of evidence\textsuperscript{a})</th>
<th>Other considerations</th>
<th>Management modifications that may be indicated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titanium allergy</td>
<td>–</td>
<td>Reduced (4)</td>
<td>Allergic symptoms after implant placement or unexplained implant failures</td>
<td>Use alternative materials</td>
</tr>
</tbody>
</table>

Adapted from Scully et al.\textsuperscript{12}

\textsuperscript{a} OCERS Levels of Evidence Working Group.\textsuperscript{14}

\textsuperscript{b} To reduce skeletal-related morbidity.

**Table 1 (Continued)**
BRONJ is a real issue for patients treated with intravenous BPs but the occurrence of BRONJ in patients receiving oral BPs medication is minimal. The use of oral BPs at the time of implant placement and during healing do not seem to affect early implant success. In a retrospective survey of 115 patients on oral BPs receiving DI (72 returned to the clinic for evaluation), oral bisphosphonate therapy did not appear to significantly affect implant success and no cases of BRONJ were registered and similarly, in a large survey performed in South Australia the estimated prevalence of BRONJ in patients under oral BPs was less than 1%.

In 2007, the American Association of Oral and Maxillofacial Surgeons produced guidelines for patients treated with oral BPs, based on the clinical situation of the patient and the length of treatment with the drug, indicating that greater caution prior and subsequent to surgery should be taken during 3 years after discontinuing BP treatment. A systematic review analysing one prospective and three retrospective series (217 patients) showed that the placement of a DI in patients with chronic intake of oral-BPs did not lead to BRONJ and did not influence short-term (1–4 years) implant survival rates. This study concluded that DI might be considered a safe procedure in patients taking oral BPs for <5 years. Similarly, in another review that included 12 studies (7 case reports and 5 retrospective studies), the authors concluded that dental implants can osseointegrate and remain functionally stable in patients treated with bisphosphonates.

In summary, there is a consensus on contraindicating implants in cancer patients treated with intravenous BPs. In patients with osteoporosis treated with BPs, they should be informed of the risk of possible implant loss the risk of suffering bony necrosis and a poor outcome from sinus lifts and adequate informed consent prior to dental implant surgery should be obtained (Table 1).

6. Head and neck cancer patients

Surgical resection of head and neck cancer can be severely mutilating. DI in oral cancer patients are successfully used for dental rehabilitation after bony reconstruction of the jaws, and for retention of a prosthetic device (e.g.: palatal obturator), used as the primary means of maxillary reconstruction. Combinations of microvascular surgical techniques and the use of DI can considerably improve the rehabilitation of people with severe head and neck defects, but there may be an increased risk of implant failure in irradiated free flap bone. It has been suggested that some patients may benefit from having the placement of DI during ablative tumour surgery.

Radiotherapy can significantly affect DI outcomes mainly during the healing period. Radiotherapy may induce endarteritis obliterans, and hence can predispose to osteoradionecrosis of the jaw. Twelve studies involving 643 DI placed in adult patients who have received radiotherapy, reported lower success rates, ranging from 40 to 100%. There are, however, several clinical studies demonstrating that DI can osseointegrate and remain functionally stable in patients who had received radiotherapy. In a series of 275 DI placed in 63 patients with oropharyngeal squamous cell carcinoma, no increase in osteoradionecrosis was reported. It has been suggested that DI may represent an acceptable option for oral rehabilitation in patients who had suffered previous osteoradionecrosis (5 year survival rate of 48.3%). Even successful DI placed during early childhood in patients treated with full dose radiation for malignant midface tumours has been reported. Other authors have reported successful DI but occurrence of late complications, such as bone loss and mucosal recession, possible due to altered saliva flow and increased bacterial colonization.

Several case–control studies have shown evidence of improved outcomes in patients with history of radiotherapy and DI with the addition of hyperbaric oxygen therapy (HBO) mainly through reduction in the occurrence of osteoradionecrosis and failing implants. However, a systematic review found only one RCT comparing HBO with no HBO for DI treatment in irradiated patients and was unable to find any strong evidence to either support or refute the use of HBO therapy for improving implant outcome.

To increase implant success in irradiated head & neck cancer patients, the following precautions should be considered:

- Implant surgery is best carried out >21 days before radiotherapy
- Total radiation dose should be <66 Gy if the risks of ORN are to be minimized or <50 Gy to reduce osseointegration failure: avoiding implant site/ports
- Hyperbaric oxygen should be given if >50 Gy radiation is used
- No implant surgery should be carried out during radiotherapy
- No implant surgery should be carried out during mucositis
- Defer implant placement for 9 months after radiotherapy
- Use implant-supported prostheses without any mucosal contact. Avoid immediate loading
- Ensure strict asepsis
- Consider antimicrobial prophylaxis.

In a study of 30 postsurgical oral cancer patients receiving 106 dental mandibular implants and adjuvant chemotherapy with either cisplatin or carboplatin plus 5-FU, there was no significant difference in implant survival at 10 years follow-up when compared with matched controls. None of the patients had been treated with radiotherapy (Table 1). To the best of our knowledge, two case series have been published reporting that cancer chemotherapy appears not to significantly impair the success of DI.

7. Cardiovascular disease

It has been suggested that some cardiovascular events such as recent myocardial infarction, stroke, and cardiovascular surgery, might represent an absolute contraindication to implant therapy. In a retrospective analysis of 246 consecutively treated DI patients, including cardiovascular disease patients, patients with a history of other systemic disease, and healthy controls, there were no significant differences in
implant failure rates between the groups.\textsuperscript{77} Moreover, in several retrospective DI cohort studies where data regarding local and systemic risk factors for implant failure had been recorded, hypertension and coronary artery disease were not associated with a significant increase in either early or late implant failures\textsuperscript{13,39,78}

In a recent case–control study, it has been suggested that intravenous sedation using midazolam and propofol during DI surgery prevented excessive increases in blood pressure, and stabilized haemodynamics,\textsuperscript{79} which could be useful in patients with cardiovascular disease. However intravenous midazolam does not prevent the myocardial arrhythmias that may arise during DI placement.\textsuperscript{80}

We could find no evidence that cardiac disorders are a contraindication to DI but it is important to consider other issues such as the occurrence of bleeding, or cardiac ischaemic during DI insertion in these patients, and therefore, medical advice should be procured before DI surgery (Table 1).\textsuperscript{22}

8. Corticosteroid therapy

Corticosteroid adverse effects include reduced bone density, increased epithelial fragility and immunosuppression.\textsuperscript{22} In consequence, the use of systemic glucocorticosteroids might compromise DI osseointegration and peri-implant healing.\textsuperscript{81} In animal models, osseointegration of implants in rabbits under experimental osteoporosis-like bone induced by glucocorticoids appeared to be compromised, which could affect biomechanical stability of implants.\textsuperscript{82} However, in most of these studies implants were placed in extraoral bones (i.e. femur or tibia), and it has been suggested that steroid administration could have less effect on the osseointegration of titanium implants in the mandible than in the skeletal bone.\textsuperscript{83} To the best of our knowledge no relevant series have been published to demonstrate if DI failure rate and/or perioperative morbidity may increase in patients under systemic corticosteroids.

There is no evidence that corticosteroid therapy is a contraindication to DI, but it is important to consider that systemic corticosteroids can cause suppression of the hypothalamo–pituitary–adrenal axis and therefore, standard recommendations for any oral surgery in patients on steroid therapy should be implemented.\textsuperscript{22} The Medicines Control Agency still advise in patients who have finished a course of systemic corticosteroids of less than 3 weeks duration and might be under stresses such as trauma, surgery or infection and who are at risk of adrenal insufficiency, to receive systemic corticosteroid cover during these periods (http://www.mca.gov.uk/ourwork/monitorsafegualmed/currentproblems/volume24-may.htm). In patients on less than 10 mg prednisolone daily (as recommended by Nicholson et al.),\textsuperscript{84} no significant events have been reported after oral surgery without steroid cover.\textsuperscript{85}

In summary, although there is no evidence that corticosteroid therapy is a contraindication to DI, medical advice should be procured in these patients prior to DI and medicolegal and other considerations suggest that steroid cover should be provided (Table 1).

9. Diabetes mellitus

Most case series, cohort studies, and systematic reviews support that DI in diabetics with good metabolic control have similar success rates when compared to matched healthy controls\textsuperscript{96–98} maintenance programme receiving conventional or advanced implant surgery (sinus floor elevation, immediate loading, and guided bone regeneration).\textsuperscript{90} However, impaired implant integration has been reported in relation to hyperglycaemic conditions in diabetic patients\textsuperscript{91} and in animal models.\textsuperscript{37,96} In a systematic literature search including 18 studies published up to 2009, the authors concluded that poorly controlled diabetes negatively affects implant osseointegration.\textsuperscript{93} This fact is consistent with the known effects of hyperglycaemic states on impaired immunity, microvascular complications and/or osteoporosis. Paradoxically, in a recent critical review it has been suggested that clinical evidence is lacking for the association of glycaemic control with implant failure, because the identification and reporting of glycaemic control was insufficient or lacking in most of the published studies.\textsuperscript{94}

In summary, there is no evidence that diabetes is a contraindication to DI therapy, but as HbA1C (glycosylated haemoglobin) may represent an independent factor correlated with postoperative complications\textsuperscript{90} and due to the known effects of hyperglycaemic states on healing, medical advice and strict glycaemic control before and after DI therapy are recommended (Table 1).\textsuperscript{22,87,95,96} Antimicrobial cover using penicillin, amoxicillin, clindamycin or metronidazole should be provided during the implant surgery.\textsuperscript{77} These patients should also quit smoking, optimize oral hygiene measures and use antiseptic mouthrinses to prevent the occurrence of periodontal and peri-implant infections.\textsuperscript{88,93,95} As implant surgery is never a matter of urgency, it has been suggested that patients should be conjointly selected and prepared by both dental practitioner and diabetes clinician.\textsuperscript{95}

10. Hyposalivation

Theoretically DI may help prosthesis retention in patients with dry mouth (hyposalivation). Although cases with hyposalivation have been successfully managed with DI\textsuperscript{98,99} and even 7 out of 8 patients with Sjögren syndrome improved their oral comfort levels with implant-retained prostheses,\textsuperscript{100} there are no systematic studies evaluating the outcomes of DI therapy in these patients (Table 1).

A retrospective study on patients suffering from rheumatic disorders such as rheumatoid arthritis and other connective tissue diseases and compromised salivary flow showed high implant survival rates (cumulative 3-year implant success rate of 96.1%). Patients with rheumatoid arthritis demonstrated acceptable marginal bone resorption and good soft tissue conditions, while other connective tissue diseases patients showed increased bone resorption and peri-implant soft tissue alterations in scleroderma patients and patients suffering from Sjögren syndrome.\textsuperscript{35} The severity of the salivary flow alteration, together with the patient’s medical condition should be evaluated before recommending DI placement.\textsuperscript{98}
Anecdotally, a case report has been published on an innovative saliva electrostimulation device fixed on a DI, placed in the lower third molar area.101

11. Immunocompromised patients

It would be reasonable to assume that DI might be contra-indicated in immunocompromised patients. In fact, in animal models it has been shown that ciclosporin impairs peri-implant bone healing and implant osseointegration.102 However, many patients receiving organ transplantation (mainly liver and kidney) with long-term ciclosporin therapy, have had successful DI therapy.103–106

Similarly, no significant problems after dento-alveolar surgery have been reported in HIV-positive patients.107,108 In a series of 20 HIV-positive subjects with mean CD4 count of 467 cells/mm³ (range: 132–948), two dental implants were placed in the anterior mandible to support an overdenture, and the short-term (6 months) success rate was 100%.109 In a recently published case–control series of HIV-positive patients receiving different regimens of highly active anti-retroviral therapy, after assessing peri-implant health at 6 and 12 months, the authors concluded that DI may represent a reasonable treatment option in HIV-positive patients, regardless of CD4 cell count, viral load levels and type of antiretroviral therapy.110 It seems that DI are well tolerated and have predictable short-term outcomes for HIV-infected individuals, but published evidence is scarce and the predictability of the long-term success remains unknown. It would seem prudent to carry out DI when CD4 rates are high and the patient is on antiretroviral therapy.

Crohn’s disease has also been suggested as a relative contraindication for DI.8 Crohn’s disease is associated with nutritional and immune defects, and hence, it may impair DI success.39 However, in a retrospective study 11 of 12 DI placed in Crohn’s disease patients integrated successfully.13

Severe periodontitis is frequent in patients with congenital neutrophil deficiencies and therefore, high occurrence of peri-implant infection should be expected when implants are placed in these patients. There are, however, some case reports of successful implant placement in patients with Papillon-Lefèvre syndrome111 and von Gierke syndrome.112

In summary, there is no evidence that immunoincompetence is a contraindication to DI therapy, but medical advice should be procured before considering DI therapy and strict anti-infective measures should be enforced when treating these patients (Table 1).22

12. Mucosal disease

There are numerous case reports and case series documenting the success of DI in patients with a range of mucosal conditions113 including ectodermal dysplasia,114-117 epidermolysis bullosa118-120 and in lichen planus (Table 1).121

DI is often the treatment of choice in patients with ectodermal dysplasia with severe oligodontia or hypodontia. The largest published series report outcomes in 51 and 33 patients, with 264 and 186 implants respectively.118,122 Presence of a limited amount of bone was a common finding, particularly in the upper arch, and often requires extensive bone regenerative procedures. Some case-series have shown that results of DI and bone grafts in adult patients affected by ectodermal dysplasia were similar to those achieved in unaffected patients.123

Most series demonstrate an excellent implant success rate in adults with ectodermal dysplasia,113 although results reported in children and adolescents mainly when implants were placed in the maxilla or the symphyseal region of the anterior mandible have been less encouraging.124,125 The most appropriate age for dental implant treatment in growing children remains controversial.117,126

A recent review, included 7 studies describing 17 patients with epidermolysis bullosa receiving 102 implants and being followed for 12 to 108 months: the implant success rate was close to 100%.127 In a small case series DI showing dehiscence or fenestration were placed simultaneously with particulated bone grafts to cover exposed threads, all implants surviving after a minimum follow-up of 12 months.128 The main reported complication during the implant surgical procedure was the formation of bleeding blisters by minimal trauma. During the follow-up period many patients also developed ulcers in the areas of prosthesis contact, but these complications did not affect the successful implant outcome. A fixed full-arch short-expand prostheses supported by four DI has been successfully used in patients with recessive dystrophic epidermolysis bullosa, minimizing oral mucosa surface contact and improving the patients’ quality of life.129

It has been suggested that dental implants are not ideal for patients with oral lichen planus because of the limited capacity of the involved epithelium to adhere to the titanium surface.7 Despite the generalized use of DI, very few case reports have been documented, all of them with successful outcome.121,126 Recently, two case–control studies including 14 and 18 oral lichen planus patients have been published, with no implant failure recorded during the follow-up period (12–53 months).131,132 Peri-implant mucositis and peri-implantitis seem to be slightly more frequent in patients with oral lichen planus than in controls, and desquamative gingivitis was associated with a higher rate of peri-implant mucositis.132 Implant placement does not influence the disease manifestations.131 As malignant transformation has been observed in few cases of oral lichen planus, careful long-term monitoring of both lesions and dental implants is recommended.113

13. Neuro-psychiatric disorders

The literature with respect to DI placement in patients with neuro-psychiatric disorders is sparse and contradictory. Some case reports and case series have shown DI treatment to be successful in some patients with various degrees of both intellectual and physical disability, including cases of cerebral palsy, Down syndrome, psychiatric disorders, dementia, bulimia, Parkinson disease and severe epilepsy.133-141 However, poor oral hygiene, oral paraphasias such as bruxism, harmful habits such as repeated introduction of the fingers into the mouth and behavioural problems are not uncommon in patients with neuro-psychiatric diseases, and DI in such
patients may lead to complications. Therefore, the success of oral rehabilitation depends fundamentally on appropriate patient selection and adequate medical advice should be sought prior to implant therapy (Table 1).

14. Titanium allergy

Degradation products of metallic biomaterials may result in metal hypersensitivity reactions. Recently, it has been suggested that titanium, formerly considered an inert material, can induce toxicity or allergic type I or IV reactions in susceptible patients and could play a critical role in implant failure. In a systematic review including 7 studies it has been shown that titanium allergy develops among patients at every age, the most common clinical manifestations being dermal inflammatory conditions and gingival hyperplasia. The prevalence of titanium allergy remains unknown but it has been estimated to be 0.6% among DI patients. A significantly higher risk of positive allergic reactions was found in patients showing allergic symptoms after implant placement or unexplained implant failures.

The risk of an allergy to titanium is increased in patients who are allergic to other metals. In these patients, an evaluation of allergy is recommended, in order to exclude any problem with titanium medical devices, and long-term clinical and radiographic follow-up has been recommended. Even in confirmed titanium-allergic patients it may be possible by using alternative materials (e.g. zirconium oxide dental implants) to achieve DI rehabilitation.

15. Conclusions

In conclusion there are very few absolute contraindications to DI treatment, although a number of conditions may increase the risk of treatment failure or complications. However, due to the scarcity of prospective studies the impact of health risks on implant outcome remains unclear and well-designed observational studies are needed.

The degree of disease-control may be far more important that the nature of the systemic disorder itself, and individualized medical control should be procured prior to implant therapy, since in many of these patients the quality of life and functional benefits of dental implants may outweigh any risks.

As in any clinical decision in dentistry, the range of treatment options and their relative advantages and disadvantages should be carefully assessed in relation to the patient’s needs and wishes. In patients with systemic conditions, it is important to weigh carefully the cost-benefit analysis with the patient’s quality of life and life expectancy and it is very important to undertake the implant surgical procedures with strict asepsis, minimal trauma, and avoiding stress and undue haemorrhage. Equally it is very important in these patients to ensure proper maintenance therapy with optimal standards of oral hygiene, without smoking and with avoidance of any other risk factors that may affect the outcome of dental implants.

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