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# Steroid Prophylaxis: The knowledge and practices of New Zealand General Dental Practitioners

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## Abstract

**Objective:** To describe the knowledge and practices of New Zealand (NZ) General Dental Practitioners (GDPs) concerning the use of steroid prophylaxis.

**Methods:** An online survey was conducted in 2013 involving a sample of 500 NZ GDPs who met inclusion criteria and had email addresses on the Dental Council register.

**Results:** A total of 214 dentists responded, giving a 44.5% response rate after accounting for undelivered questionnaires. Nearly two-thirds (61.7%) did not currently recommend corticosteroid prophylaxis, although nearly three-quarters (74.8%) believed that dental treatment posed a potential risk to patients with adrenal suppression. Over half (53.4%) believed that oral corticosteroids could cause adrenocortical suppression, and a similar proportion (58.3%) believed that a specific dose of oral prednisolone of 7.5 mg per day could do so. Most practitioners (79.6%) supported the formulation of steroid prophylaxis guidelines.

**Conclusion:** Despite most NZ GDPs believing the dental setting to pose a risk of adrenal crisis for patients taking corticosteroids, there is some confusion among dentists identifying at-risk patients and their ability to manage if such an event was to occur in their practices. There is further confusion over whether steroid prophylaxis is warranted for perceived at-risk patients, and which regime to follow when it is. There is an associated tendency to be over-cautious when determining the need for steroid prophylaxis, and to rely on their undergraduate steroid prophylaxis guidelines when doing so. There is a need for evidence-based guidelines to be formulated by an expert panel.

## Introduction

Adrenal insufficiency (AI) is an endocrine disorder with an estimated prevalence of 40-140 per million (Khalaf et al, 2013). Secondary AI is more common than primary AI; it can result from the action of exogenous glucocorticoids suppressing adrenocorticotrophic hormone release, leading to decreased glucocorticoid levels (Miller et al, 2001). There is a poor correlation between hypothalamic-pituitary-adrenal (HPA) axis function and cumulative dose, highest dose or duration of exogenous steroid therapy (Schlaghecke et al 1992; LaRochelle et al, 1993). Because

of individual variability in the degree and duration of adrenal suppression, it is difficult to accurately predict which patients will develop AI when glucocorticoid treatment is discontinued (Jung and Inder, 2008). Cortisol is the principal glucocorticoid steroid and plays a vital role in the body's response to stress. During biological stress, susceptible patients with AI can experience a life-threatening adrenal crisis due to their diminished adrenal reserve and cortisol production (Omori et al, 2003; Milenkovic et al, 2010; Khalaf et al, 2013). Primary AI poses a higher risk of precipitating adrenal crisis than secondary AI (Khalaf et al, 2013). Acute adrenal crisis can result in abdominal pain, fever, fatigue, hypotension, dehydration, nausea and vomiting. It can lead to hypothermia, hypoglycaemia, hypovolaemic shock and cardiovascular failure requiring immediate diagnosis and urgent medical treatment starting with intravenous glucocorticoid and fluids to restore blood pressure.

High-dose, long-term steroids have become more frequently prescribed in Western medicine. There has been growing concern among General Dental Practitioners (GDPs) that dental treatment could precipitate adrenal crises in patients managed with such therapy. This concern originates from numerous published case reports detailing such occurrences since the 1950s. Recent systematic reviews, however, have revealed that true adrenal crises in dentistry have been considerably over-reported and cast doubt on the need for steroid prophylaxis. Only two certain cases of adrenal crisis occurring following dental treatment have been reported (Aono et al, 1999; Milenkovic et al, 2010). In both cases, primary AI was undiagnosed and no steroid prophylaxis had been provided. Features common to both reports include AI in patients over 40 years old, the presence of significant oral infection, and oral surgical procedures performed under general anaesthetic. Major surgery is a potent activator of the HPA axis (Naito et al, 1991; Naito et al, 1992), and general anaesthesia alone will increase cortisol levels rise (Crozier et al, 1987; Udelsman et al, 1987). No cases of AI have been reported in patients undergoing oral surgery procedures under local anaesthesia (Shepherd et al, 1998; Gibson and Ferguson, 2004).

A recent Cochrane review examined the need for additional steroids during oral surgery, and only two randomized control trials withstood critical evaluation (Glowniak and Loriaux, 1997; Thomason et al, 1999). Both trials reported no change in blood pressure whether or not additional steroids were given during surgery, suggesting that steroid prophylaxis during oral surgery is unnecessary (Yong et al, 2012). Routine non-surgical dental procedures do not stimulate cortisol production at levels comparable

to those of oral surgery (Miller et al, 1995). Moreover, because of the dearth of literature on HPA axis suppression in susceptible patients during dental procedures, it can be difficult to predict adrenal crises and make evidence-based recommendations for their prevention (Yong et al, 2012). Physiological theory suggests that AI patients require additional glucocorticoid doses during severe illness or surgery, but evidence for this (as well as the optimal dose, frequency and duration of supplemental therapy) remains contentious. The side-effects of long-term steroid administration are consistent with Cushing's Syndrome, but it is highly unlikely that those would result from a single course of glucocorticoid therapy; this argument supports the safety of steroid prophylaxis. Many sets of recommendations exist for the use of steroid prophylaxis in dentistry; while not replacing clinical judgment and discretion, such recommendations may ensure that patients with AI survive stressful episodes without excessive steroid dosing. Some guidelines have been sourced from clinical observation (Perry et al, 2003; Arlt and Allolio, 2003; Gibson and Ferguson, 2004; Hahner et al, 2005), while others are based on estimated cortisol production rates associated with different levels of stress (Salem et al, 1994; Glowniak and Loriaux, 1997; Miller et al, 2001). Blanket recommendations for steroid cover are no longer supported by the evidence; alongside the apparent confusion in the literature over whether steroid prophylaxis is even required (and, if so, for which patients and procedures), there is a need for clarification on the topic. Accordingly, this study was conducted to investigate New Zealand GDPs' current understanding and practice of steroid prophylaxis.

## Methods

Prior to undertaking this study, ethics approval was gained from the University of Otago's Human Ethics Committee. A short series of questions was formulated to suit the style of SurveyMonkey™; a medium for conducting web-based surveys. Questions explored steroid-prophylaxis-associated knowledge and current practices among general dentists. The sample was selected from the 2013 NZ Dental Council Register. Excluded from the sampling frame were all specialists and practitioners who did not hold current Annual Practising Certificates, those suspended from practising, hygienists, therapists, technicians, NZ residents practising overseas and all who had not supplied an email address. From a pool of 1250 eligible participants, 500 were randomly selected and sent an email in July 2013. Included in that email was an information letter with an invitation to participate and an electronic link to the survey. By opening the link to the survey, participants gave implied consent. To encourage participation, an incentive was offered in the form of a prize draw to win a case of wine, generously sponsored by a local winery. Respondents could elect to go into the draw to win this upon completion of the survey. Three rounds of reminder emails were sent to encourage participation. Data were analysed using SPSS (version 20). Chi-square tests were used to determine the statistical significance of observed differences between groups. A P value of <0.05 was considered significant.

## Results

Of the 500 GDPs emailed, nine emails bounced back and ten respondents opted out of the survey; generating a final sample of 481. A total of 214 responded, leading to a response rate of 44.5%. A number (29) did not complete the entire survey, which was accounted for in the analysis stage. Respondents and non-respondents did not differ significantly from the current NZ dental workforce by age, place of graduation or sex. Some 41.1% of the respondents were female, and 78.6% of respondents gained their primary dental qualification in NZ.

A small minority of respondents (3.9%) reported having encountered an adrenal crisis in patients treated in dental practice. There was a clear gradient across dentists' graduating cohorts from the older to the younger graduates in those having done so, with 9.5% of those who graduated before 1980 and 1.4% of those who graduated in 2000 or later having experienced it. Similarly, a small percentage of respondents (5.4%) had heard of colleagues experiencing an adrenal crisis in a dental patient and this was lower in respondents who had gained their qualification at Otago than among those gained overseas (4.3% and 9.3% respectively).

Data showing dentists' self-assessment of their knowledge and skills required for management of adrenal crises are presented in Table 1. Fewer than half of respondents thought themselves to have poor knowledge of the topic, and nearly half rated their venepuncture skills to be unsatisfactory, with more females admitting to this than males. Three-quarters believed the risk of adrenal crisis occurring in dental practice is not overemphasized, with a majority identifying there to be a potential risk of an adrenal crisis event in a patient on corticosteroid medication.

Data summarising dentists' beliefs on which dental procedures could instigate an adrenal crisis in at-risk patients are presented in Table 2. Almost three-quarters believed that multiple extractions or minor oral surgery under local anaesthesia put patients in danger of an adrenal crisis, but very few believed that any single aspect of routine dental treatment would put a patient in danger. A significantly higher percentage of males than females believed multiple extractions to be an at-risk treatment.

More than half of the sample (58.3%) believed that a dose of more than 7.5 mg of oral prednisolone a day would necessitate steroid prophylaxis, but about one-quarter (26.4%) were unsure of which dose would necessitate corticosteroid prophylaxis. Some 44.7% believed that it would take months for the adrenal cortex to recover to its original state; 30.1% believed that weeks were necessary, while a minority (6.3%) believed that either years or no amount of time would allow for recovery. Just over half (53.4%) believed that oral corticosteroids alone would cause adrenocortical suppression, while only 1.5% felt that inhalational corticosteroids would result in suppression; 27.2% believed that both can cause suppression, and 5.3% did not believe that either would.

Data pertaining to GDPs' beliefs and implementation of corticosteroid prophylaxis for at-risk patients are presented in Table 3. Two-thirds did not recommend

**Table 1:** GDPs' understanding of adrenal crisis risk and its management (brackets contain percentages)

	Risk is overemphasised	Knowledge rate is poor	Venepuncture skills are poor
Sex			
Female	14 (17.5) <sup>a</sup>	26 (32.9)	46 (60.5)
Male	38 (34.2)	44 (41.1)	41 (46.1)
Place of Graduation			
Otago	43 (28.3)	57 (38.5)	172 (55.0)
Other	9 (23.1)	13 (34.2)	15 (44.1)
Year of Graduation			
Before 1980	9 (23.7)	13 (35.1)	13 (40.6)
1980-1989	8 (19.5)	15 (37.5)	20 (58.8)
1990-1999	13 (30.2)	17 (39.5)	17 (37.7)
2000 and later	22 (31.9)	25 (37.9)	37 (57.8)
Overall	52 (25.2)	70 (37.4)	87 (42.2)

<sup>a</sup> P<0.05**Table 2:** GDPs' beliefs about dental procedures that could instigate an adrenal crisis in at-risk patients (brackets contain percentages).

	No dental procedures	All dental procedures	LA single-tooth extraction	LA multiple extractions or minor oral surgery	Restorative dentistry	Scaling & root planing
Sex						
Female	8 (6.3)	27 (21.4)	35 (27.8)	72 (57.1) <sup>a</sup>	7 (5.6)	6 (4.8)
Male	3 (3.4)	17 (19.3)	30 (34.1)	62 (70.5)	6 (6.8)	10 (11.4)
Graduation Year						
Before 1980	4 (9.1)	12 (28.6)	8 (19.0)	24 (57.1)	1 (2.4)	3 (7.1)
1980-1989	4 (9.1)	13 (29.5)	13 (29.5)	25 (56.8)	5 (11.4)	2 (4.5)
1990-1999	2 (4.3)	8 (17.4)	17 (37.0)	29 (63.0)	3 (6.5)	2 (4.3)
2000 and later	3 (4.1)	11 (14.9)	27 (36.5)	56 (75.7)	4 (5.4)	9 (12.2)
Graduation Place						
Otago	9 (5.6)	33 (20.4)	51 (31.5)	107 (66.0)	13 (8.0)	16 (9.9) <sup>a</sup>
Other	2 (4.5)	11 (25.0)	14 (31.8)	27 (61.4)	0 (0.0)	0 (0.0)
Overall	11 (5.9)	44 (23.4)	65 (34.6)	134 (71.3)	13 (6.9)	16 (8.5)

<sup>a</sup> P<0.05**Table 3:** GDPs' beliefs and implementation of corticosteroid prophylaxis for at-risk patients (brackets contain percentages)

	Recommend corticosteroid prophylaxis		Willingness to treat at-risk patients		Give corticosteroids prophylactically	
	Yes	No	Yes	No	Yes	No
Place of Graduation						
BDS from Otago	55 (36.9)	94 (63.1)	110 (73.8)	39 (26.2)	63 (38.9)	99 (61.1)
Other	17 (43.6)	22 (56.4)	25 (64.1)	14 (35.9)	20 (45.5)	24 (54.5)
Year of Graduation						
Before 1980	11 (28.9)	27 (71.1)	26 (68.4)	12 (31.6)	13 (31.0)	29 (69.0)
1980-1989	12 (28.6)	30 (71.4)	32 (76.2)	10 (23.8)	13 (29.5)	31 (70.5)
1990-1999	13 (33.3)	26 (66.7)	23 (59.0)	16 (41.0)	15 (32.6)	31 (67.4)
2000 and later	36 (52.2)	33 (47.8)	54 (78.3)	15 (21.7)	42 (56.8)	32 (43.2)
Overall	72 (38.3)	116 (61.7)	135 (71.8)	53 (28.2)	83 (40.3)	123 (59.7)

corticosteroid prophylaxis for patients perceived to have adrenal insufficiency, and this was higher among Otago graduates. There was also a gradient by graduation cohort, with those who graduated earlier being less likely to recommend corticosteroid prophylaxis. Three-quarters are willing to treat patients perceived to be at risk of developing an adrenal crisis, with the newest graduating cohort of 2000 or later being most willing and the 1990-99 graduating cohort the least. More University of Otago graduates than overseas-trained dentists give corticosteroids prophylactically for patients who are currently on corticosteroid medications. There was also a gradient across the graduation cohorts, with those who graduated earlier being less likely to implement corticosteroid prophylaxis.

Overall, 79.6% of respondents were in support of the formulation of guidelines for the use of prophylactic corticosteroids. A higher percentage of overseas-trained dentists than locally-trained dentists believed there was a need for guidelines (87.2% and 77.6% respectively). Although a substantial proportion (87.0%) of the most recently trained dentists believed that there is a need, there was no clear gradient over the year groups. Fewer than half of the respondents (49.3%) follow a set protocol or guideline. With regard to preferred corticosteroid administration regimes, a large proportion of respondents said that they would double the patient's current dose of corticosteroids (68.3%), while the remainder indicated a variety of different methods, including a 20 mg oral dose of prednisolone and consultation with GPs or specialists. Over half of the GDPs surveyed reported using the guidelines they were taught in their undergraduate training (56.5%) while others used textbooks, journal articles, guidelines taught to them by a specialist or articles published in a dental news bulletin.

## Discussion

This study was undertaken to investigate the perceived confusion among dental practitioners—both present in practice and in published literature—on the use of steroid prophylaxis in dentistry. Our objectives were devised to evaluate clinical practice on this topic so that we could reflect on current protocols of use (if any were utilised). We also intended to explore GDPs' knowledge of the practice in order to clarify understanding of the topic and provide timely and relevant reflection on the practice of steroid prophylaxis use among NZ GDPs.

In considering the weaknesses and strengths of this study, a higher response rate would have enhanced confidence in the generalisability of the findings. Every effort was made to improve participation, including multiple reminder emails and an incentive prize draw offer. In spite of these efforts, the participation rate failed to exceed 50%. This appears to be a recent trend in internet-based surveys of NZ GDPs; for example, a recent survey of their attitudes to fluoridation also had a relatively low participation rate (Grant et al, 2013). In that and the current study, several technical difficulties were encountered, not the least being problems with inaccurate email addresses and GDPs using non-specific practice email addresses. Not all dentists on the Dental Register had provided email addresses, which may have

resulted in a higher proportion of younger dentists being sampled. Despite these problems, it did appear that a representative sample of respondents was obtained with respect to gender, year of graduation and place of graduation, which closely resembled that of the New Zealand dental workforce<sup>1</sup>.

Most responding GDPs estimate the prevalence of adrenal crisis occurring in dentistry in NZ to be very low. The majority believed there could be a risk of an adrenal crisis occurring when a patient taking corticosteroids undergoes any dental treatment, with this risk increasing immensely when treatment involves surgery or multiple extractions. These responses suggest a shift in importance placed on adrenal crisis occurring in NZ dentistry, much like the current shift in evidence for its occurrence in the literature. The estimated prevalence of adrenal crises occurring in the dental setting was higher among older dentists and overseas-trained dentists. This simply may indicate that older dentists with more years of practice (and overseas-trained dentists with perhaps more work experience in countries with larger populations) have had more cumulative exposure to such crises, despite their rarity. On the other hand, it could also suggest that older dentists may have misdiagnosed crises, a phenomenon which may have been influenced by the older literature, which is now known to have over-reported such instances (Gibson and Ferguson, 2004).

Responding dentists showed uncertainty in identifying patients who are at risk of an adrenal crisis and whether such patients then require steroid prophylaxis. From the literature, we know that only two cases of adrenal crisis in the dental setting have been diagnosed with certainty and that, in both cases, it involved primary AI patients undergoing dental procedures under general anaesthesia. However, almost two-thirds of NZ GDPs specified that a dental patient taking a dose of 7.5 mg of oral prednisolone per day would meet the criteria for adrenal insufficiency and so require steroid prophylaxis. Surprisingly, the remaining one-third of dentists were unsure of which dose of prednisolone or its corticosteroid equivalent a patient would have to be taking in order to require steroid prophylaxis. This suggests some consistency to published guidelines, although we were unable to identify such. Furthermore, no study was found in our literature search showing that 7.5 mg prednisolone taken orally once daily causes AI and that this would require steroid prophylaxis in the dental setting. For reference and a comparison, an Australian recommendation for steroid prophylaxis (Gibson and Ferguson, 2004) and a New Zealand recommendation have been provided in Table 4. Given that there is no clear evidence basis for this practice, further research should be encouraged.

Responses revealed a degree of confusion about the time required for an adrenal cortex to recover after exogenous corticosteroid therapy, with a substantial proportion indicating that it would take months, and another opting for weeks. Physiologically, recovery of the hypothalamic-pituitary-adrenal axis occurs within two

<sup>1</sup> <http://www.dcnz.org.nz/assets/Uploads/Publications/workforce-analysis/Workforce-Analysis-2009.pdf>





**Table 4:** A comparison of existing Australian and New Zealand steroid prophylaxis recommendations.

Exogenous steroid dose used by patient (daily)	Australian recommendation (Gibson and Ferguson, 2004)	New Zealand recommendation (University of Otago)
Less than 7.5 mg prednisolone	No supplementation for local or general anaesthetic procedures.	No supplementation for local or general anaesthetic procedures.
More than 7.5 mg prednisolone	For a local anaesthetic procedure, double the usual dose on day. For general anaesthetic minor surgical procedures, 100 mg hydrocortisone IM <sup>a</sup> and maintain usual dose.  For general anaesthetic major surgical procedures, 100 mg hydrocortisone bolus and 50 mg 8 hourly for 48 hours and maintain usual dose.	For a local anaesthetic procedure, double the usual dose on day. For general anaesthetic minor surgical procedures, 100 mg hydrocortisone IM/IV <sup>a</sup> and maintain usual dose.  For general anaesthetic major surgical procedures, 100 mg hydrocortisone bolus and repeat 50-100 mg every 8-12hrs as appropriate
Greater than 20.0 mg prednisolone		No supplementation required for minor surgical procedures.  Supplement as appropriate for major surgery under general anaesthesia

<sup>a</sup>IM = intramuscularly; IV = intravenously

months following cessation of high-dose steroids, but that does not necessarily reflect the functional status of an individual patient's adrenal cortex (Gibson and Ferguson, 2004). Thus, when to consider an adrenally insufficient patient as no longer so is difficult to determine, much as our respondents indicated.

If an adrenal crisis were to occur in a dental setting, dentists would need to have sufficient knowledge, clinical skills and resources to manage the acute condition while waiting for the assistance of emergency services. Our findings indicated that NZ GDPs perceive themselves as lacking the facilities and skills for managing an acute adrenal crisis event. This is cause for concern, because a majority felt that there was a risk of this occurring in dental practice. This may support the case for the cautious practice of generalised implementation of prophylaxis for any dental patient who is perceived to have adrenal suppression (given the lack of appropriate management if an adrenal crisis were to occur). Alternatively, it may support further education and practice in emergency medicine, such as implementing frequent IV cannulation courses for GDPs or appropriate referral to hospital dentistry services if GDPs are not comfortable treating such patients.

Fewer than half of the respondents reported giving corticosteroid prophylaxis; among those who did, there was considerable variation in the protocol used. This lack of uniformity in clinical practice reflects the current confusion and possibly the absence of established guidelines. This suggests that guideline formulation and promulgation would be beneficial, a view that was supported by a majority of the respondents. Many reported that they utilise guidelines provided in undergraduate training programmes. In order to formulate

guidelines on this topic, additional research would be required, such as an investigation into the policies on steroid prophylaxis adopted by different dental schools or hospitals. A similar pilot study was undertaken in the United Kingdom in 2003, investigating the similarities and differences in university teachings on the use of steroid prophylaxis for dental patients taking therapeutic doses of corticosteroids (Perry et al, 2003). Reflecting our findings, they identified considerable variation in the management of these patients and concluded that the fabrication of a standardised national policy document should be considered.

Moreover, we believe that an evidence-based review of this topic by an expert panel of a governing body is warranted, along the lines of the recent simplification of antibiotic prophylaxis guidelines in NZ dentistry. It is hoped that, following this study, progress can be made in creating more certainty and consistency in the practice of steroid prophylaxis in dentistry, thereby increasing GDPs' confidence in managing adrenally-insufficient patients. With our increasing life expectancy and ageing population, GDPs are likely to be exposed to more patients on high-dose corticosteroid medication, and so this further work is somewhat urgent.

To conclude, this investigation found that, despite most GDPs believing that the dental setting poses a risk of adrenal crisis to patients taking corticosteroids, GDPs are not confident in their understanding of adrenal insufficiency and they may not have the knowledge or skills to manage an adrenal crisis if one were to occur. There is confusion about whether steroid prophylaxis is warranted for perceived at-risk patients and which practice to follow when it is. There is an associated tendency to be over-cautious when prescribing steroid

prophylaxis, and GDPs rely on their undergraduate steroid prophylaxis guidelines when doing so. There is a need for evidence-based guidelines to be formulated by an expert panel and then extensively promulgated.

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