A FEASABILITY STUDY OF AN ORAL DEVICE TO PROMOTE WEIGHT LOSS

Study Protocol

Research Personnel

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BACKGROUND

Definition of normal, overweight and obesity

One may define whether a person is underweight, normal weight, overweight or obese, by measuring their height and weight. By dividing the weight in kilograms by the height in metres squared, one may calculate the body mass index (BMI = $\frac{\text{Weight in kg}}{\text{Height in m}^2}$).

People with normal weight have a BMI of 20 to 25, whereas underweight is less than 20. Overweight is defined as a BMI of 25 to 30, whilst obesity is defined when a person present with a BMI of 30 or over. A person with a BMI of over 40 is considered 'morbidly obese'.

Complications of Obesity

Obese people may suffer physical symptoms such as general discomfort, shortness of breath, reduced mobility and pain in the joints. Psychological symptoms may be present, including embarrassment, depression and loss of self-esteem. Obese people may suffer eating disorders, together with stigmatisation and discrimination.

Overweight and obesity are associated with a variety of medical conditions, including diabetes, high blood pressure, elevated blood cholesterol level, risk of stroke and coronary artery disease, osteoarthritis, a disorder of breathing during sleep called 'sleep apnoea syndrome', gallstones, chest disorders and various cancers (Ministry of Health 2015). Both overweight and obese people have a risk of reduced life expectancy. On average, severely obese people die 8-10 years sooner than those of normal weight; every 15 extra kilograms increases risk of early death by approximately 30% (OECD 2014). However, weight reduction may improve life expectancy and also reverse many of the medical conditions that are associated with obesity.

Prevalence

New Zealand and other developed countries are suffering an epidemic of overweight and obesity, with serious health, economic, and social consequences. A 2014 OECD study reported that 31.3% of New Zealanders aged 15 years and over

were obese (OECD 2014), a significant increase from the 17% reported in 2001 (Wilson et al. 2001). New Zealand rates of obesity are only exceeded by Mexico (32.4%) and the USA (35.3%) (OECD 2014). The health care costs of obesity in New Zealand were estimated at around NZ$135 million in the late 1990s (Swinburn et al. 1997). Obesity in New Zealand also demonstrates marked social inequalities, with 48% of Māori and 68% of Pacific Islander adults being obese (Ministry of Health 2015). People with less education and lower socio-economic status, especially women, are also more likely to be obese (OECD 2014).

Treatment Options

Alterations in diet and physical activity are the mainstays of initial treatment. Calorie restriction and increased energy expenditure should be successful, although in many people the effects are either negligible or only successful in the short term, because of poor motivation and brief adherence to lifestyle changes. After successful weight reduction, some people may attempt to prevent weight regain by applying a tight cord around the waist which provides a psychological and physical barrier to this.

A variety of drugs have been tried as adjuncts to diet therapy. Earlier drugs were related to the amphetamine group and had serious side effects, some addictive properties and are not generally used today. More recent derivatives of those drugs have been withdrawn from the market because of potential serious side effects. Drug therapy has only been proven to be helpful in the short or medium, rather than in the long term, and continued drug therapy may not only have side effects, but is also expensive. More recent drug innovations include Orlistat, which blocks fat digestion, and Sibutramine, which promotes a sense of satiety. Both drugs have various contra-indications and side effects. However, once morbid obesity is present, eating habits are firmly established and difficult to change in an environment of plentiful food, exercise is limited by body bulk and drugs and diet will have little effect.

Increasingly, bariatric surgery is being used to treat obesity, with significant cost and a high risk of morbidity. Bariatric surgery, however, is not suited to all patients and surgical complications are common. Although reasonably low, there is a clear mortality risk associated with this surgery. The increasing numbers of bariatric procedures are estimated to reach 200,000 annually in the United States and half a million annually

worldwide (Buchwald et al. 2007). It is estimated that less than 2% of the morbidly obese population are receiving bariatric surgery (Buchwald and Oien 2013). Because there is still reluctance to accept obesity, and even morbid obesity, as a disease entity, the surgery for this problem and its operative mortality are not well accepted by the medical and lay communities. Although metabolic/bariatric surgery plays a major role in the management of the morbidly obese today, it cannot be relied upon to manage the global obesity epidemic. Alternative strategies are required which may obviate surgery, or which reduce weight prior to surgery and so make it easier and safer.

The upper and lower jaws may be approximated by the technique of jaw wiring. Fixing the jaws together prevents the normal intake of food and only liquid is possible. Jaw wiring has been a successful aid to diet therapy, either as a precursor to surgery, or as a true alternative, and studies have shown that it is as effective as surgery in inducing major weight loss (Garrow and Gardiner 1981). Jaw wiring has the advantage that it is non-surgical, no anaesthetic is required and it is relatively non-invasive. Most studies of jaw wiring have only lasted approximately 6 months, and beyond that period success in preventing weight regain has involved the use of a waist cord. Conventional jaw wiring has not been tried in the long term, as it is uncomfortable due to cheek and tongue irritation as well as direct trauma to the gums surrounding the teeth that have been wired. The general discomfort, eating difficulties and bad breath that results from stagnant food debris results in poor long-term tolerance. The wiring severely restricts oral hygiene and the patient's dentition is at increased risk of developing dental decay and periodontal disease. There is also a small risk that patients may choke if they try to eat solid food whilst their jaws were wired, or if they vomit.

Magnetic dental splints

Magnetic dental splints provide a novel approach to the treatment of obesity. They could be used in the short, medium or long term, either continuously or intermittently. The use of magnets and the absence of complete jaw approximation avoid the rare potential hazard of choking on solid food. They make it difficult to chew, but the patient can open the mouth in an emergency with a special tool. These splints allow more effective dental hygiene than can be achieved with wiring. They can be used as an adjunct to other therapy such as dietetic advice, exercise prescription and

drugs, or as a precursor to or an alternative to surgical operations, such as gastric bypass procedures.

Magnetic dental splints could be used to treat many more obese patients than currently done with operative procedures. At present there are long waiting lists in New Zealand for bariatric surgery, and magnetic dental splints provide a realistic, attractive and economic alternative to surgical procedures. They may also be useful for a short period, allowing desired weight loss prior to bariatric surgery. The device could be helpful for short term weight loss with a certain goal, such as in obese patients who require knee or hip replacement surgery, but who will only get their procedure if they lose a defined lower weight.

The Device

Unobtrusive, light in weight and very thin dental bands are fixed to the posterior teeth by a combination of temporary dental cements and a unique locking screw. They are individually made after recording detailed impressions of the patient's jaws and then mounting these on an articulator to study the way the opposing jaws meet. The bands cover the upper and lower back teeth and incorporate titanium magnets and opposing keepers (Figure 1). The magnetic system keeps the teeth tightly opposed making chewing very difficult. However, their configuration maintains the airway, allows speech and feeding using a liquid diet.

Figure 1: Device composed of metal bands and titanium magnets.

In an emergency, the mouth can be opened by the jaw muscles, aided by a special tool. The splints can be removed by the dentist to allow for dental examinations, maintenance and hygiene treatment.

Aims of the Study

This feasibility study aims to investigate the practicality, comfort, tolerability and safety of an intra-oral device and the magnitude of weight loss achieved during the study period. The expected weight loss over 4 weeks is around 10% of body weight.

Subjects

Ten obese patients will be invited to participate in this study aimed at facilitating weight loss. Patients who require treatment for obesity and are interested in taking part in this project will be recruited from an existing panel of subjects who have participated in research studies previously (*e.g.* The POWER Study, Endocrinology Research Unity, Department of Medicine). These participants represent a relatively balanced potential pool of participants that are representative of the age, gender and ethnicity of those with obesity in the general population in Dunedin. Inclusion criteria include a BMI of over 35, no major co-occurring health conditions that may affect the ability of participating in the study, and a healthy mouth with a sound posterior dentition. Participants using continuous positive airway pressure (CPAP) devices to manage sleep apnoea are not eligible. Males and females aging 20-65 of all ethnicities will be invited to participate. Any patient who is on oral medication that cannot be givein in liquid form; diabetic patients on insulin; and any patient with diabetes on oral hypoglycaemic therapy will be excluded from the study.

Methods

All patients will give informed consent and may withdraw from the study at any time. A dental inspection will confirm each individual's suitability for the study and baseline screening tests will be performed including a medical history, dietary assessment, and measurement of weight and height. Separation elastics, which are commonly used in orthodontics, will be placed to allow for a reversible separation of the teeth. When adequate separation of the teeth is achieved, a dental impression will be

taken to allow for the manufacture of the dental device. The technology consists of a customised device made from components already available commercially but linked by a specifically-designed attachment. This device is cemented to four of the patients' upper and lower teeth. It consists of stainless steel orthodontic-type metal bands wrapped around four posterior teeth. A closed magnet and its keeper are attached to the upper and lower bands, which then restricts mouth opening. A safety-feature allows the disengagement of the device in case of an emergency (e.g. vomiting).

With the device in place, the participant is able to drink and speak normally, but chewing becomes extremely difficult. The magnetic dental splints prevent chewing of food and the patients will be given a liquid diet for 4 weeks. The diet consists of commercially available Fortisip Drinks (Nutricia), a nutritionally complete formula containing essential vitamins and minerals. Fortisip provides 300kcal/200ml bottle. Local dietitians of the Southern District Health Board will supervise and prescribe the liquid diet. Those participants that meet the eligibility criteria will commence a 4 week low calorie diet (LCD) consisting of 1200kcal/day (4 Fortisip bottles per day, plus some extra low calorie liquids such as tea, coffee and diet lemonade). During this 4-week phase participants will see a dietitian on a weekly basis.

During the study, ten participants will receive dental, dietetic and medical supervision before, during and after device placement. Subjects will be reviewed 24 hours and at 3, 7, 14, 21 and 28 days after the device has been placed. The comfort and tolerability of the device will be assessed, together with the resultant weight loss, at each time point. During the feasibility study, qualitative and quantitative data will be collected on: tolerance of the device, effect on oral health, weight loss, and acceptability to patients. These will be assessed using standard and modified Quality of Life (QoL) questionnaires. Data collected will inform further development and modification of the device, if needed. This feasibility study will test the tolerance of the concept of fixed magnetic dental splints as a treatment modality, allowing for further development and application of the technology to a larger study in the future. A 24 hour helpline will be given to all subjects.

Data Analysis

1. Comfort and tolerability of the device will be after four weeks using a visual analogue scale.

2. Dental hygiene assessments will be recorded by the dentist at each visit.

3. Weight will be recorded before and weekly to the end of the study.

4. Body composition will be assessed by electrical impedance.

Data and safety monitoring processes

All data collected will preserve confidentiality and anonymity. Participants will be assigned a number code for de-identification purposes and data will be stored in a password-secured computer. This study will follow standard monitoring practices adopted in similar clinical research at the Faculty of Dentistry of the University of Otago.

References

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PARTICIPANT INFORMATION SHEET

FEASIBILITY STUDY OF AN ORAL DEVICE TO PROMOTE WEIGHT LOSS

Invitation to take part

You are being invited to take part in a research study. Before you decide to take part, it is important for you to understand why the research is being done and what it will involve.

Please take time to read the following information carefully. Please discuss it with others if you wish. Ask us if there is anything that is not clear, or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

This study will try out a new treatment for overweight people. People can lose weight if they eat less, but most people can't stick to a diet for more than a week or two. This study tries out a new way of helping people to eat less and so stick to their diet. The idea is to use a very thin, lightweight device which fits over your back teeth. The little device fits over the upper and lower back teeth on both sides of the jaw. Each one contains tiny magnets, so that when you close your mouth, the magnets make it very difficult to chew (Figure 1). Instead of eating solid food, you will be given a liquid diet. This liquid diet is low in calories and so you should lose weight.

With the device in place you will be able to talk, drink, swallow, and breathe easily, but opening and closing your mouth, and so eating solid food, will be quite difficult. You will be able to open your mouth in an emergency and you will be shown how to do this.

A dentist will examine your teeth to see if they are suitable for you to wear the magnetic device. If you are suitable, the dentist will make the device to fit the shape of your teeth.

The main aim of the study is to see how you tolerate wearing the device and how comfortable it is, and how much weight you can lose in four weeks.

Figure 1: Device composed of metal bands and titanium magnets.

This study lasts four weeks. During that time, we will see if the bands are comfortable and if you find them acceptable as a treatment for losing weight. If you are happy with wearing the splints and you have started to lose weight, then you may be approached to carry on wearing the device for longer periods in future studies.

Why have I been chosen?

You have been chosen because losing weight would be helpful for your overall health. You should take part in this study if you have had difficulty in losing weight with diets in the past.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this Information Sheet to keep and be asked to sign a Consent form. If you decide to take part you are still free to withdraw from the study at any time and without giving your reason. If you decide to withdraw from the study at any time, or decide not to take part in the study, this will not affect you in any way.

What will my participation in the study involve?

Your teeth will be examined by a dentist to see if you are suitable to take part in this study. If your teeth are suitable, then the dentist will make the devices to fit your teeth. The devices will be applied so that you will find it difficult to chew and eat solid food. A dietitian will give you advice about a liquid diet, which you will be able to take and swallow easily. This liquid diet will be low in calories and so you should lose weight. The liquid diet will be provided to you for the duration of the study at no cost. The study will last for one month. During this time, you will be monitored by the research team at

24h, 3 days, 7 days, 14 days, 21 days and 28 days after device placement, and will be requested to fill in questionnaires about your experience with the device and the impact of weight on your quality of life. Some of these questions might be personal/sensitive.

At the end of four weeks, you will be weighed and your teeth inspected. You will be monitored for one year by the study multidisciplinary team to assess if the weight loss has continued or not, and if it has had any impact in the your eating habits and lifestyle. This monitoring involves phone calls and a visit to the study team after one year.

If you agree to take part in the study, you must agree to stick to the liquid diet while you are wearing the magnetic devices. If you try to eat and chew solid food, there is a chance that you could choke. If you do choke, you will be able to open your mouth and we will show you how to do this if there is an emergency. You must also agree to attend the clinic when requested for a checkup.

All the participants in this study will try the device and your weight before and after taking part will be compared.

What do I have to do?

You must follow the diet advice that you are given and stick to the liquid diet. You must not take any solid food whilst you take part in the study. If you are on tablet medication, then this needs to be discussed with the doctor supervising the study, so that suitable medication is provided. You may need to crush your tablets or we may need to supply a liquid medication instead of tablets.

Explanation of the procedure that is being tested

This study will try out a magnetic device to make it difficult for people to chew, compared with being on their usual diet for weight reduction. In the past, people have had their jaws wired together to help them stop eating. Jaw wiring is a very effective way of losing weight, but it may be uncomfortable and cleaning your teeth can be difficult. The magnetic device tried in this study should be so comfortable so that you can't notice it is there, and you should be able to clean your teeth.

You also will be given a card stating that you are in a study of a new treatment for weight loss which gives the telephone details of the doctors supervising the trial.

Alternative treatment

Instead of using the magnetic device, you could have tablets to help you lose weight, or have an operation to staple and reduce your stomach, which means that you can only eat smaller meals.

What are the potential disadvantages and risks of taking part?

You may feel hungry on the liquid diet while you lose weight.

The device may feel uncomfortable and if it is, then you will need to have it adjusted by the dentist supervisor of the trial.

If you attempt to eat solid food there is a risk that you may choke. If you are sick, there is a chance that some vomit could go in your windpipe and cause choking. You will be shown how to open your mouth in an emergency, if necessary.

You may withdraw from participation in the study at any time and without any disadvantage to yourself.

How do I open my mouth in an emergency?

You may feel the need to open your mouth in an emergency, for example if you feel sick. You may be able to open your mouth if you try very hard with your jaw muscles. You can help by pulling your mouth open by holding your nose and your chin. You will also be given a metal tool to aid device opening, like a shoe horn, and be shown how to use it.

When the magnets are fitted, the dentist will make sure that you can open your mouth for emergencies.

EMERGENCY TELEPHONE NUMBER:

PROF. PAUL BRUNTON
Office - Faculty of Dentistry, University of Otago
9.00am – 5.00pm Monday - Friday
03 479 7039

Mobile: 021 2797041 24 hours

What are the possible benefits of taking part?

We hope that this treatment will help you and that you will lose some weight during the study.

What if new information becomes available?

While you take part in the study new information could become available about your treatment. You will be told if this happens and you will always have the choice of leaving the study at any time. If you leave the study, your normal care will continue. If you continue with the study, you will be asked to sign an updated consent form. If some new information becomes available, your research doctor may advise you to leave the study in your best interests. Any reasons for doing this and arrangements will be explained to you.

What happens when the research study stops?

At this stage, it is not intended for anybody to use the dental device for more than four weeks at a time. If you wish to continue for longer than four weeks, you could be entered in a further follow up study.

What happens if something goes wrong?

In the unlikely event that you are harmed by taking part in this research project, this could be covered under the terms of the accident compensation legislation with its limitations. While a claim may be lodged, it is always up to ACC to accept or decline your claim. If you have any questions about ACC, please feel free to ask the researcher for more information before you agree to take part in this study.

If you have any queries or concerns about your rights as a participant in this study, you may wish to contact the local Health and Disability Services Consumer Advocate:

Telephone: (03) 479 0265 or freephone 0800 377 766 or
Free fax: 0800 2787 7678 (0800 2 SUPPORT) or
Email: advocacy@hdc.org.nz

If there is a specific Maori issue or concern, please contact Prof. John Broughton, Assoc. Dean Maori .
Telephone: (03) 479 7639
Email: john.broughton@otago.ac.nz

Will taking part in the study be kept confidential?

If you consent to take part in this research study, your medical records will be inspected by the doctors and dentists conducting the study. If you take part, then this is confidential and no one else will know apart from you, the study doctors and dentists, and your GP will be informed. The fact that you are taking part in the study will be in the hospital notes and any other hospital doctor that needs to know this will be able to see this in your notes. The normal rules of Health Service confidentiality apply to this study.

When the project is completed, all personal identifying information will be removed from the paper records and electronic files which represent the data from the project. Paper records will be kept in locked cabinets. Electronic data will be stored on a password secured computer stored at the Faculty of Dentistry. The computers will be contained within locked rooms, in alarm activated area of the respective buildings. Data collected during the duration of this study will be stored for at least 10 years.

What will happen to the results of the research study?

If the research study shows a positive result, then the researchers will hope to publish the results in an appropriate journal within 12 months of the end of the study. All patients who take part in the study will be told the eventual results. Any publication will be confidential and the details of individual patients will not be made available to anyone outside the study. You cannot be identified personally from any publication about the study.

Who is organising and funding the research?

This study is organised by Prof. Paul Brunton, Dean of the Faculty of Dentistry, Prof. Jim Mann and Dr. Patrick Manning, the Edgar Diabetes and Obesity Research Center. The work on this study has been financed by the Faculty of Dentistry and other grants. None of the doctors or dentists conducting this research will be paid for carrying out the research. You will not be paid for taking part in the study and there are no expenses to be paid to you for travelling costs for you to attend for your appointments.

Contact for further information

If you require any further information then please feel free to discuss this with Prof. Paul Brunton at the Faculty of Dentistry, University of Otago, telephone 03 479 7039.

You will be given a 24 hour helpline number in case of problems.

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CONSENT FORM

FEASIBILITY STUDY OF AN ORAL DEVICE TO PROMOTE WEIGHT LOSS

Please tick to indicate consent to the following:

I have read, or have had read to me in my first language, and I understand the Participant Information Sheet.	Yes ☐	No ☐
I have been given sufficient time to consider whether or not to participate in this study.	Yes ☐	No ☐
I have had the opportunity to use a legal representative, whanau/ family support or a friend to help me ask questions and understand the study.	Yes ☐	No ☐
I am satisfied with the answers I have been given regarding the study and I have a copy of this consent form and information sheet.	Yes ☐	No ☐
I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without this affecting my medical care.	Yes ☐	No ☐
I consent to the research staff collecting and processing my information, including information about my health.	Yes ☐	No ☐
If I decide to withdraw from the study, I agree that the information collected about me up to the point when I withdraw may continue to be processed.	Yes ☐	No ☐
I consent to my GP or current provider being informed about my participation in the study and of any significant abnormal results obtained during the study.	Yes ☐	No ☐
I understand that my participation in this study is confidential and that no material, which could identify me personally, will be used in any reports on this study.	Yes ☐	No ☐
I understand the compensation provisions in case of injury during the study.	Yes ☐	No ☐
I know who to contact if I have any questions about the study in general.	Yes ☐	No ☐

I understand my responsibilities as a study participant.	Yes ☐	No ☐
I wish to receive a summary of the results from the study.	Yes ☐	No ☐

Declaration by participant:
I hereby consent to take part in this study.

Participant's name: _____

Signature: _____ Date: _____

Declaration by member of research team:

I have given a verbal explanation of the research project to the participant, and have answered the participant's questions about it.

I believe that the participant understands the study and has given informed consent to participate.

Researcher's name: _____

Signature: _____ Date: _____