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A comprehensive review of eating disorders and their implications on oral health

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A COMPREHENSIVE REVIEW OF EATING DISORDERS AND THEIR IMPLICATIONS ON ORAL HEALTH

by

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B.A., Boston University, 2010

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A COMPREHENSIVE REVIEW OF EATING DISORDERS AND THEIR IMPLICATIONS ON ORAL HEALTH

PARDIS KOLEINI
Boston University School of Medicine, 2013

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ABSTRACT

In today’s world, eating disorders are plaguing adolescent women at alarming rates. Anorexia nervosa and bulimia nervosa are the two most common disorders and differ in their symptoms and prognoses. While the symptoms of these diseases are not readily visible in systemic health, deteriorating oral health can be a positive indication of abnormal eating habits. Anorexia nervosa and bulimia nervosa result in declining systemic health due to resulting nutritional imbalances and physical harm that patients exert upon themselves. Malnutrition results in altered endocrine function and consequent loss of menstruation, abnormal hair growth, and decreased peak bone mass. Although risk factors for anorexia nervosa and bulimia nervosa vary, the resulting nutritional impoverishment produces the similar systemic effects.

In addition to systemic health degradation, symptoms of anorexia and bulimia commonly manifest in the oral cavity. Chemically, salivary composition may be altered resulting in lower pH values. Patients may also exhibit temporary
bilateral parotid gland swelling as a result of repeated purge episodes. The most critical oral effect of repeated purge episodes is loss of permanent enamel and is defined as perimolysis. Presently, research does not agree on whether or not eating disorders elevate the risk of dental carries.

Although current literature unanimously agrees on the importance of early oral health detection and diagnosis of eating disorders, most dentists are not trained to properly identify and diagnose the manifestations of AN and BN within the oral cavity. Dental school and dental hygiene curriculums lack emphasis on the severity of eating disorders in general and do not allot adequate teaching hours for this matter. Sadly, even when dentists suspect the presence of eating disorders, they are not likely to intervene.

Fortunately, full recovery is possible in eating disorder patients if proper therapy and medical attention is provided in a timely manner. Damaged dentition may also be fully restored with the use of crowns, composite fillings, and porcelain veneers. However, if disordered eating habits persist after dental restoration, the dentition will once again erode and deteriorate accordingly.

Anorexia nervosa and bulimia nervosa are serious diseases that need proper attention and medical intervention. Their severity should not be minimized as they may ultimately result in grave side effects and eventual death. Dental health practitioners have the ability to observe the presence of these diseases before others as obvious symptoms may present in the oral cavity. Dentists and dental hygienists need to be educated on the oral manifestations of eating
disorders and proper protocol regarding timely intervention. With proper education and knowledge, dental health practitioners can reduce the severity of disease, resulting in better prognoses for patients.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>i</td>
</tr>
<tr>
<td>Reader's Approval Page</td>
<td>ii</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>iii</td>
</tr>
<tr>
<td>Abstract</td>
<td>iv</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>vii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>ix</td>
</tr>
<tr>
<td>List of Figures</td>
<td>x</td>
</tr>
<tr>
<td>List of Abbreviations</td>
<td>xii</td>
</tr>
<tr>
<td><strong>INTRODUCTION</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>ANOREXIA NERVOSA</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>BULIMIA NERVOSA</strong></td>
<td>6</td>
</tr>
<tr>
<td><strong>RISK FACTORS FOR EATING DISORDERS</strong></td>
<td>9</td>
</tr>
<tr>
<td><strong>SYSTEMIC EFFECTS OF EATING DISORDERS</strong></td>
<td>13</td>
</tr>
<tr>
<td><strong>BULIMIA NERVOSA BIOMARKERS</strong></td>
<td>17</td>
</tr>
<tr>
<td><em>Streptococcus sobrinus</em></td>
<td>17</td>
</tr>
<tr>
<td>Serum Amylase</td>
<td>18</td>
</tr>
<tr>
<td><strong>ORAL HEALTH IMPLICATIONS OF BULIMIA NERVOSA AND ANOREXIA NERVOSA</strong></td>
<td>19</td>
</tr>
<tr>
<td>Salivary Composition</td>
<td>19</td>
</tr>
<tr>
<td>Salivary pH</td>
<td>19</td>
</tr>
</tbody>
</table>
Parotid Gland Enlargement 20
Salivary Flow Rate 22
Periodontal Manifestations of Eating Disorders 24
Damage to the Oral Mucosa 26
Dental Erosion in Eating Disorder Patients 27
Dental Caries 31
Osteonecrosis of the Maxilla and Mandible 32

DISCUSSION 34
Importance of Early Detection and Prevention by Dentists
and Lack of Eating Disorder Education in Dental School
Curriculum 34
Treatment 39
Conclusion 45
References 49
Vita 53
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Health Dieting VS. Anorexia</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>The American Psychiatric Association’s diagnostic criteria for anorexia nervosa and bulimia nervosa</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>The American Psychiatric Association’s diagnostic criteria for anorexia nervosa and bulimia nervosa</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>Risk factors associated with eating disorders</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>General traits of eating disorders included in oral health curriculum</td>
<td>37</td>
</tr>
<tr>
<td>6</td>
<td>Views on eating disorders in dental and dental hygiene programs</td>
<td>38</td>
</tr>
<tr>
<td>7</td>
<td>Recommendations to prevent further dental deterioration in eating disorder patients</td>
<td>41</td>
</tr>
<tr>
<td>Figure</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>1</td>
<td>Russel’s Sign of right hand dominant patient on his/her right hand</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>Anorexia induced Lanugo hair growth and acne on the face and neck of a 28 year old restrictive type anorexia nervosa patient</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>Ptosis in a patient with weak orbital muscles</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>Parotid gland swelling in bulimia nervosa patient</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>Feeling of oral dryness and its relation to functionality in bulimia nervosa Patients versus controls</td>
<td>23</td>
</tr>
<tr>
<td>6</td>
<td>Plaque accumulation and subsequent gingival inflammation</td>
<td>25</td>
</tr>
<tr>
<td>7</td>
<td>Atrophic Glossitis on dorsal surface of tongue</td>
<td>26</td>
</tr>
<tr>
<td>8</td>
<td>Riboflavin deficiency induced angular cheilitis</td>
<td>27</td>
</tr>
<tr>
<td>9</td>
<td>Relating common pH values. Please take note of the closeness in values of gastric fluid and battery acid</td>
<td>29</td>
</tr>
<tr>
<td>10</td>
<td>Labial erosion of dentition due to high consumption of acidic foods and beverages</td>
<td>30</td>
</tr>
<tr>
<td>11</td>
<td>Perimolysis of the palatal surfaces of maxillary dentition in a bulimia nervosa patient, complete with raised amalgam restorations</td>
<td>31</td>
</tr>
<tr>
<td>12</td>
<td>Bisphosphonate induced osteonecrosis of the jaw</td>
<td>33</td>
</tr>
<tr>
<td>13</td>
<td>Full mouth restoration in bulimia nervosa patient</td>
<td>42</td>
</tr>
<tr>
<td>14</td>
<td>Full mouth restoration of eroded dentition with all amalgam</td>
<td>42</td>
</tr>
</tbody>
</table>
restorations replaced by non-acid soluble composite

15 Probability of remission in bulimia nervosa patients. Sample consisted of 86 patients who had not engaged in binge/purge episodes for a minimum of eight weeks
# ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN</td>
<td>Anorexia Nervosa</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>BN</td>
<td>Bulimia Nervosa</td>
</tr>
<tr>
<td>DSM</td>
<td>Diagnostic and Statistical Manual 4th edition</td>
</tr>
<tr>
<td>EDNOS</td>
<td>Eating Disorders Not Otherwise Specified</td>
</tr>
<tr>
<td>fMRI</td>
<td>fluorescent Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>IDC</td>
<td>International Classification of Diseases</td>
</tr>
</tbody>
</table>
INTRODUCTION

Anorexia nervosa (AN) and bulimia nervosa (BN) are two diseases that slowly and silently deprive their victims of livelihood. These disorders are potentially the most life-threatening of all mental illnesses due to their chronic nature manifesting in decades of illness (Campbell & Aulisio, 2012). Eating disorders can often be hidden well while deteriorating the patient’s psychological and systemic health. Because they are psychiatric diseases, anorexia nervosa and bulimia nervosa often go unnoticed until extensive damage has been done to the individual's body. The root of these illnesses is a distorted body image with the common desire to lost weight and be thinner.

Medically, eating disorders are classified as AN, BN, atypical anorexia nervosa, and Eating Disorders Not Otherwise Specified (EDNOS) in the Diagnostic and Statistical Manual 4th edition (DSM). Additionally, the International Classification of Diseases (IDC) further includes psychogenic loss of appetite and vomiting associated with other psychological conditions in its classification of eating disorders (Frydrych, Davies, & McDermott, 2005). Otherwise specified EDNOS includes disorders in which the victim experiences some but not all diagnostic criteria, yet clearly has crossed into the diseased state (Sirin, Yucel, Firat, & Husseinova-Sen, 2011).

Eating disorders are multifactorial diseases that can either be clearly distinct in their nature or have pathological conditions intertwined with one
another. For example, a young woman who suffers from AN is likely to later develop BN and binge eating habits. While these diseases typically affect adolescent and young women, men surprisingly constitute 10-20% of patients suffering from AN and BN. Unfortunately, the prevalence and distribution of eating disorders is difficult to determine as all patients deny their diseased state (at least initially) (Willumsen & Graugaard, 2005).

Annually, anorexia nervosa, bulimia nervosa, and EDNOS affect five million Americans. These diseases continue to increase in prevalence due to the intense pressure that women face to maintain unrealistic body images. Adolescent women are starting to diet much sooner and at alarming low ages. One survey conducted in northern California found that eighty percent of girls ages eight to ten years old had dieted at least once in their short lifetime (Bretz, 2002).

**Specific Aims**

While the cause and symptoms vary, both anorexia and bulimia have poor prognoses when proper care is not provided. In order to properly understand the magnitude of these diseases, this paper must begin by thoroughly defining each; then proceed to review the risk factors for eating disorders, including potential biomarkers. The systemic health effects of AN and BN and the consequent oral health manifestations will be examined. The effects of eating disorders on the oral cavity will emphasize the importance of symptom recognition by dental
health care providers, the lack of eating disorder education in dental curriculums, and potential oral and systemic health treatment plans.

**ANOREXIA NERVOSA**

Anorexia nervosa is a severe mental illness that affects young women from early on, with an average presentation age of just sixteen years old (Milosevic, 1999). Eating disorders are the third most prevalent chronic disease among adolescent girls (Shaughnessy et al., 2008), with anorexia affecting 0.7% of women between the ages of sixteen and thirty-five years old (Willumsen & Graugaard, 2005). The rate equates to around nine people per one hundred thousand of the total population (Milosevic, 1999). The DSM 4th edition states that the criteria from AN diagnosis is “intense fear or weight gain or becoming fat, even though underweight” (Gaudio & Quattrocchi, 2012). This disease is multifactorial, resulting in a fear of food due to the detrimental interactions between biological, social, individual, and familial factors (Milosevic, 1999).

Additional diagnostic criteria state:

- Individual weighs less than eighty-five percent of the age appropriate body weight (Frydrych et al., 2005)
- Body Mass Index (BMI) of individual is less than eighteen kg/m² (Shaughnessy et al., 2008)
- Individual possesses a completely distorted body image (Frydrych et al., 2005)
- Individual has acquired Amenorrhea (Frydrych et al., 2005)
Amenorrhea is defined as the absence of at least three consecutive menstrual cycles, and is a strong indication of deteriorating systemic health (Frydrych et al., 2005). Upon self-evaluation, an anorexic patient perceives his/her body in a disturbed manner and observes the body's shape in a way that is not literal. Despite his/her undernourished appearance, the patient will cognitively think that he/she is fat and should lose more weight. Additionally, the anorexic patient will not view his/her low body weight as problematic, is in constant denial of impending health risks (Gaudio & Quattrocchi, 2012). The pathogenesis of this disease revolves around the dissatisfaction of the individual with his/her body (Table 1) (Lo Russo et al., 2007).

**Table 1.** Health Dieting VS. Anorexia. Shown is the comparison of healthy dieting verses those with anorexia nervosa (“Graphs on Eating Disorders,” 2011).
Anorexia nervosa is divided into two types: the restricting type and the binge/purge type. The restricting type patient limits his/her caloric intake to an extreme level, while the binge/purge type occasionally will have a caloric binge followed by a compensatory purging behavior (Table 2). Examples of purging behavior are self-induced vomiting, strenuous exercise, and use of laxatives, diuretics, or enemas to induce weight loss (Milosevic, 1999). Restrictive type and purging type anorexia are not mutually exclusive and can compound to lead to extreme deterioration of the individual's health (Lo Russo et al., 2007).

Table 2. The American Psychiatric Association’s diagnostic criteria for anorexia nervosa and bulimia nervosa (De Moor, 2004).

1. Refusal to maintain body weight over a minimal normal weight for age and height, e.g. weight loss leading to maintenance of body weight 15% below that expected; or failure to make expected weight gain during periods of growth, leading to body weight 15% below that expected

2. Intense fear of gaining weight or becoming fat, although underweight

3. Disturbance in the way in which one’s body weight, size, or shape is experienced, e.g. the person claims to ‘feel fat’ even when emaciated, believes that one area of the body is ‘too fat’, even when obviously underweight

4. In females, absence of at least three consecutive menstrual cycles when otherwise expected to occur (primary or secondary amenorrhoea) (a women is considered to have amenorhea if her periods occur only after hormone, e.g. oestrogen, administration)
Due to the chronic nature of eating disorders, AN may plague victims throughout their entire lives. Severely diseased patients must be hospitalized to achieve stabilization prior to the traditional therapeutic recovery approach. The seriousness of AN should not be underestimated as the mortality rate is a disturbingly high forty-five percent for patients whose average lifetime BMI averages at 10.5kg/m². This shocking mortality rate can be attributed to the extreme degree of malnutrition that patients subject themselves to, eventually manifesting in cardiovascular symptoms among many others (Gaudiani, Braverman, Mascolo, & Mehler, 2012). In addition, the mortality rate is twelve times higher in anorexic patients between the ages of fifteen and twenty-four than all other cause of death among this demographic (DeBate et al., 2007).

BULIMIA NERVOSA

Bulimia nervosa is also a severe psychological disorder that results in rapid health deterioration. The American Psychiatric Association first recognized bulimia in 1980 (McCreedy, 2006). The International Classification of Diseases identifies BN as a disorder in which binge eating is observed followed by a subsequent compensatory behavior. Binge eating is defined as the consumption of large quantities of food to an uncontrolled degree (Frydrych et al., 2005). The criteria for bulimia diagnosis include:

- An obsessive mental relationship with food
- Compensatory behavior following binge eating episodes,
- An ever-present fear of weight gain
Compensatory behavior is defined as any behavior that negates the effects of compulsive binge eating. Examples include excessive laxative use, diuretic use, or extreme exercise. The diagnostic criteria for BN is similar to that of AN but differs mainly in the fact that a diagnosis of bulimia requires the occurrence of binge eating episodes (Frydrych et al., 2005). It is often more difficult to readily identify bulimic patients as they may either be over their expected weight range or ten percent within it (Milosevic, 1999).

The DSM 4th Edition also requires the presence of compensatory behavior, but also includes self-judgment and evaluation based solely on body shape and weight. Even if all symptoms are not present, studies indicate common incidence of eating disorder associated behavior among adolescent girls. Eighty-six percent of teenage girls surveyed in France admitted to utilizing self-induced vomiting as a means of weight management on at least one occasion (Frydrych et al., 2005).

Similarly to AN, BN is a psychological disorder resulting from increasing social pressures that women face to maintain unrealistic bodies. The victims' subsequent metabolic and nutritional imbalances result in un-suppressible cravings. The individual will eat large quantities of food to calm the craving, and then engages in the previously defined compensatory behavior to calm his/her guilt (Bretz, 2002).

Bulimia nervosa is more prevalent than anorexia with an incidence of
fourteen people per one hundred thousand of the total population. On average, this disease affects one to two percent young women (Milosevic, 1999). Eight to twenty percent of the total diseased population comprises of high school aged girls, with total prevalence range of 4.8 – 12.5%. In addition, ten to twenty percent of college-aged women have admitted to engaging in Bulimic tendencies (Bretz, 2002). Alarmingly, eighty-five percent of bulimic women receiving treatment have an average age of nineteen years, causing bulimia to be approached as an epidemic among college aged women (Table 3) (McCreedy, 2006).

**Table 3.** The American Psychiatric Association’s diagnostic criteria for anorexia nervosa and bulimia nervosa (De Moor, 2004).

<table>
<thead>
<tr>
<th>Bulimia Nervosa</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Recurrent episodes of binge eating (rapid consumptions of a large amount of food in a discrete period of time)</td>
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<td>2. A feeling of lack of control over eating behavior during eating binges</td>
</tr>
<tr>
<td>3. Regularly engaging in either self-induced vomiting, use of laxatives or diuretics, strict dieting or fasting, or vigorous exercise to prevent weight gain</td>
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<tr>
<td>4. A minimum average of two binge-eating episodes a week for at least 3 months</td>
</tr>
</tbody>
</table>
While the average eating disorder ratio of women to men is ten to one, bulimia is twenty five times more likely to effect women than men. Additionally, this disease may be observed in conjunction with other inappropriate behavior such as harmful and promiscuous sexual tendencies, theft, or substance abuse (Milosevic, 1999). Bulimic patients may go out of their way to hide symptoms and behaviors from friends and family, resulting in rapidly deteriorating health without proper treatment. If left untreated, one in three hundred bulimia nervosa cases will result in mortality (McCreedy, 2006).

**RISK FACTORS FOR EATING DISORDERS**

Because eating disorders are extremely complex, many factors compound together to ultimately result in a diseased state. The most prevalent risk factor purely environmental. Young girls are bombarded by unrealistic media images of what a woman’s ideal body should be, and feel ever increasing pressure to lost weight (Lo Russo et al., 2007). Fashion industries have established the optimal female body as strikingly thing, and young girls constantly strive to achieve this unattainable image (Milosevic, 1999).

A victim’s physical shape may also be a risk factor. If someone has a genetic predisposition to carry excess weight, they may develop an unhealthy obsession with removing the excess weight (Lo Russo et al., 2007). The genetic basis of anorexia is supported by studies that demonstrate parallel development of diseased state in identical twins (Milosevic, 1999).
Personality traits may also contribute to a diseased state if victims are constantly seeking others’ approval, and striving to fit into their preconceived notion of what is socially acceptable (Lo Russo et al., 2007). Patients are usually hypercritical of their own bodies see constant room to improve (Milosevic, 1999).

The common factor that triggers all eating disorders is a lack of self-esteem. The difference, however, is the way in which one’s self esteem diminishes to the point of developing these diseases. In many cases, victims experience a traumatic event in early childhood that leads to the slow decline of mental health. These early traumas can range from sexual, mental, or physical abuse, parental negligence, and peer abuse (i.e. bullying). Dysfunctional families have the tendency to be over-protective, over-bearing, and simply too controlling. When parents possess unrealistically high expectations for the children, the child will grow more and more insecure when he/she doesn’t meet their expectations. Consequently, families of anorexic patients are often described as “over achieving” and “conflict avoiding”, while the victim tends to be a quiet introvert (Milosevic, 1999).

While most risk factors are universal for both AN and BN, a few are exclusive for bulimia. The most distinct risk factor for bulimia is childhood obesity, which reads to early (sometimes premature) onset of menstruation. The result of childhood obesity is an obsession with dieting from a very young age, and constant mind consuming thoughts of weight loss. Both bulimic patients and their families tend to be immature on an emotional level, but still strive for
perfectionist. In contrast to Anorexia, Bulimic patients tend to be extroverted individuals who are less readily noticeable as they are rarely underweight (Milosevic, 1999). The weight of bulimic patients ranges from average to up to ten pounds overweight, whereas anorexic patients tend to be below eight-five percent of their ideal body weight (DeBate, Tedesco, & Kerschbaum, 2005; Shaughnessy et al., 2008).

In addition to environmental, social, and familial triggers, AN has been shown to have a neural basis as well. Anorexic patients literally see and feel their own body as larger than reality and have distorted self-images. For example, and emaciated anorexic patient may visually perceive himself/herself as having an abnormally large abdomen when his/her abdomen may be concave.

Studies investigating body image distortion have shown that it is a multifactorial symptom that can be identified by neuroimaging. This solidifies the neural basis of AN. Body image distortion is comprised of three different components: perceptive (perception of one’s own body image/weight), affective (satisfaction with one’s own body), and cognitive (mental beliefs regarding one’s own body size and shape). These components can be isolated and identified through fluorescent Magnetic Resonance Imaging (fMRI) images. While alterations in these neural circuits may predispose patients to AnN, it is very likely that psychological and environmental factors combine with neural predisposition to produce a diseased state (Table 4)(Gaudio & Quattrocchi, 2012).
Table 4. Risk Factors associated with eating disorders (Milosevic, 1999).

Risk Factors Associated with Eating Disorders
- **Biological:**
  - Fat Metabolism
  - Abnormal 5HT Function
- **Demographic:**
  - Female
  - Social Class
- **Familial:**
  - Family Dysfunction
  - Positive Family History
- **Occupational:**
  - Models
  - Dancers
  - Athletes
- **Psychological:**
  - Stress
  - Low Self Esteem
  - Perfectionism
  - Depression

In general, unhealthy familial situations will diminish a child’s confidence to the point where he/she will live for the approval of others. Consequently, individuals use food and diet to manipulate their distorted body images and supplement any insecurity (Lo Russo et al., 2007). Dieting foreshadows eating disorders and failed dieting results in insecurity and increased guilt (Milosevic, 1999).
SYSTEMIC EFFECTS OF EATING DISORDERS

While the focus of this paper is the effect of eating disorders on oral health specifically, it is important to understand the broad range of health effects that result. Most problems are caused by the nutritional deficiencies caused by food deprivation. Patients may become emaciated and possess blue discolored skin (known has cyanosis). This cyanosis is caused by constriction of the skin’s arterial and venous dilation, and may be an defensive instrument to guard from loss of body heat (Jesitus, 2010). Dehydration and electrolyte imbalance are grave implications that lead to serious cardiac problems ranging from bradycardia to hypotension, and starvation has been shown to result in reduced left ventricular mass. Sadly, cardiac complications are among the most common causes of death attributed to AN (DeBate et al., 2005; Jesitus, 2010; Milosevic, 1999).

Eating disorders manifest in the endocrine system by causing menstrual irregularities and ovarian changes, with subsequent decreased fertility. Endocrine dysfunction is very serious and can result in amenorrhea, regression to prepubescent state, and growth stunting (DeBate et al., 2005; Milosevic, 1999). The gastrointestinal system is also slowly damaged due to constant acid regurgitation in purging patients (DeBate et al., 2005).

One obvious indication of purging type eating disorders is the formation of a callus on the index finger of the patient’s dominant hand. This callus is called a “Russel's Sign” and is caused by the constant scraping of the epidermis against
the patient’s maxillary incisor’s while purging (Figure 1). Russel’s signs are an easy way to spot eating disorder patients and can detection can be used to provide treatment (McCreedy, 2006).

![Image of Russel's Sign](image.jpg)

**Figure 1.** Russel’s Sign of right hand dominant patient on his/her right hand (Milosevic, 1999).

Because anorexic patients tend to be more impoverished and underweight than a bulimic patient, they may exhibit more severe endocrine implications. Anorexic patients may start to grow fine, pigmented hair all over their body in regions previously lacking hair (Figure 2). This condition is known as Lanugo and is exclusive to AN patients. The most common regions of new hair growth are the arms, back, and torso. Lanugo growth is caused by the decline of proper endocrine function, leading to anorexia induced hypothyroidism. However, the patient’s lack of body fat and emaciation lead to consequential loss of head hair,
alopecia, or basic hair fragility. Endocrine imbalance also leads to severe acne, dry, brittle, and cracked nails, as well as deteriorating renal and liver function. In (Rita D. DeBate et al., 2005; Jesitus, 2010). Anorexia induced hepatitis has been noted in extremely anorexic patients whose lifetime body mass index averages at 10.5kg/m² (Gaudiani et al., 2012).

**Figure 2.** Anorexia induced Lanugo hair growth and acne on the face and neck of a 28 year old restrictive type anorexia nervosa patient (Jesitus, 2010).

As previously mentioned, malnutrition is the antecedent to most systemic health problems correlated with eating disorders. A depleted nutritional state ultimately affects the central nervous system leading to grave implications. Several cases analyzed by Gaudiani et al. in 2012 reported that every organ
system faced serious complications, including the ocular system. Five severely anorexic patients reported dry eyes, photophobia, lagophthalmos (can’t close eyelids completely, ptosis (drooping eyelids), and enophthalmos (globe is physically smaller than normal). These symptoms are caused by facial nerve paralysis are attributed to the depletion of orbital fat mass and reduced orbital muscle function. When there is too much open space between the globes and eyelids, pollutants and irritants can easily adhere to the globes, causing further irritation. While simple weight restoration did not resolve ophthalmic symptoms, complications were seemingly reversible with proper ophthalmic treatment. Patients being treated for anorexia nervosa were simultaneously given topical eye ointment and their eyelids were taped shut overnight. Ophthalmic symptoms cleared in eleven days (on average) (Gaudiani et al., 2012).

Figure 3. Ptosis in a patient with weak orbital muscles (Simon, Chacko, & Challu, 2011).
Eating disorders are especially harmful because they can occur at a very young age that is pivotal to an individual’s growth. Consequently, the early onset of malnutrition results in compromised peak bone mass in young women. Osteoporosis, defined as the loss of bone mass, may have serious health implications as it is associated with low trauma fractures. Because this disease is silent and has no obvious symptoms, it is essential for health care providers to understand who is at risk. Osteoporosis and osteopenia have been reported to occur as soon as six months after the onset of amenorrhea in anorexia patients (Lo Russo et al., 2007). If left untreated, AN will lead to low bone mass and increased risk for osteoporosis at an uncharacteristically young age (Shaughnessy et al., 2008).

**BULIMIA NERVOSA BIOMARKERS**

*Streptococcus sobrinus*

Bulimia nervosa and anorexia nervosa (purge-type) have the potential to be identified on a microbiological level in patients who regularly engage in self-induced vomiting. Overtime, the normal flora in the patient’s mouth will be replaced with a more acidic flora due to the consistent lowering of intra-oral pH. Specifically, several studies have found a marked difference in salivary levels of the gram-positive bacteria *Streptococcus sobrinus* in bulimic patients in comparison to demographic matched controls. *Streptococcus sobrinus* is a bacteria that thrives at a low pH, and its survival is depends on “sucrose
mediated attachment to the pellicle on the tooth’s surface” (Bretz, 2002). Bulimic patients have higher intraoral levels of sucrose as a result of frequent binge eating episodes. Therefore, *Streptococcus sobrinus* is highly active in the mouths of patients with BN versus patients without as their frequent self-induced vomiting (consequent low intraoral pH) and increased intraoral sucrose levels create a favorable environment for this bacterium.

Furthermore, bulimic patients who were treated with the anti-depressant Fluoxetine for sixteen weeks showed a remarkable reduction in salivary *Streptococcus sobrinus* levels (as their self-induced vomiting arrested). Bulimic patients who were treated with a placebo showed no decrease in salivary *Streptococcus sobrinus* levels. The decreased *Streptococcus sobrinus* levels correlate with a reduction in self-induced vomiting and binge eating episodes. The results of this study indicate that salivary *Streptococcus sobrinus* levels have the potential to act as a biomarker for bulimia nervosa and purge-type anorexia nervosa (Bretz, 2002) (Milosevic, 1999).

**Serum Amylase**

Recent research has indicated the elevation of serum amylase in twenty-five to sixty percent of bulimia nervosa patients. It is important to note that this rise in serum amylase is attributed specifically to the salivary gland and not the pancreas. While the exact mechanism of elevation is not yet understood, there is a strong positive correlation between serum amylase and frequency of self-induced vomiting. However, this serum amylase elevation is not related in
anyway to the magnitude of illness. Serum amylase, like Streptococcus sobrinus, can be used as a bulimia nervosa marker (Frydrych et al., 2005).

**ORAL HEALTH IMPLICATIONS OF BULIMIA NERVOSA AND ANOREXIA NERVOSA**

**Salivary Composition**

In addition to decreased salivary flow rates in bulimic patients, salivary composition has also been tested for immunoglobulins, total protein content, and salivary electrolyte content. While bulimic patients exhibited significantly higher levels of salivary amylase, concentrations of immunoglobulins and electrolytes remained the same. Specifically, Frydrych et al. evaluated salivary levels of potassium, chloride, calcium, urea nitrogen, and salivary albumin. The results of their investigation indicated that the salivary chemistry and composition remained the same in bulimic patients versus their control group. However, Milosevic found that the average bicarbonate concentration in bulimic patients was significantly lower than control groups, while salivary viscosity was significantly greater (Frydrych et al., 2005; Milosevic, 1999).

**Salivary pH**

The investigation of salivary pH is important because decreased pH alters the microflora of the oral cavity and encourages the growth of non-native flora. While several investigations differ on their analysis of salivary pH, Frydrych et al.
found that salivary pH is directly related to bicarbonate concentration and increasing bicarbonate levels will increase intraoral pH, while bicarbonate concentration is directly dependent on salivary flow rate. Therefore, when salivary flow is decreased, bicarbonate concentration will also be reduced with the ultimate effect of reduced intraoral pH.

The conflicting results regarding salivary pH may be attributed to varying methods of salivary collection and analysis. In their study, Dynesen and colleagues provided subjects with an oral citric acid rinse and evaluated the resulting intraoral pH. They concluded that normal pH was restored within fifteen minutes post-rinse. These results demonstrate the need for the development of a standardized approach to pH investigation. Collecting results in one universal manner will produce more concurrent data (Dynesen et al., 2008) (Frydrych et al., 2005).

**Parotid Gland Enlargement**

Swelling of the parotid glands is a very common manifestation of bulimia nervosa and is observed in ten to fifty percent of diagnosed cases (Figure 4) (De Moor, 2004). Parotid swelling is referred to as sialadenosis and is defined as “a non-inflammatory enlargement of the salivary glands caused by a peripheral autonomic neuropathy, which is responsible for disordered metabolism and secretion” (Lo Russo et al., 2007). This bilateral enlargement is painless and is caused by repeated self-induced vomiting, repeated binge eating episodes, abnormally high digestion of starch, and functional hypertrophy (Dynesen et al.,
Swelling occurs two to six days after post-purge, and is not observed in patients who do not engage in self-induced vomiting (De Moor, 2004). Sialadenosis results in reduced functionality of the glands and ultimately results in decreased salivary flow rates. The swelling of the glands remains after full recovery from bulimia and anorexia and gradually declines over time (Lifante-Oliva et al., 2008).

Figure 4. Parotid gland swelling in bulimia nervosa patient (O’ Kelley Wetmore, 2012).

Research has found the development of necrotizing sialometaplasia on hard palates of bulimic patients as a cause of the traumatic intraoral environment. Pathologically, necrotizing sialometaplasia may be mistaken for
invasive carcinoma due to their visual similarities. It is important for dental practitioners to have the ability to correctly diagnose necrotizing sialometaplasia in order to avoid unnecessary surgical biopsy and procedure (Lo Russo et al., 2007).

**Salivary Flow Rate**

When comparing resting salivary flow rates in patients with BM to restrictive-type anorexics, vomiting bulimics demonstrated dramatically lower rates. This decreased flow can be attributed to the benign enlargement of the parotid gland that is common in bulimia nervosa patients (Milosevic, 1999).

While resting salivary flow rate was reduced in diseased patients, Milosevic observed a significant increase in flow just prior to vomiting. This increased flow rate is a consequence to self-induced vomiting as the salivary nuclei are signaled by medullary center in the brain (where the action of vomiting is controlled) to increase function just prior to vomiting. Additionally, the consequential nausea induced by binge eating episodes (excessive stomach distension) also triggers increased salivary flow (Milosevic, 1999).

Reduced resting salivary flow rate is a directly caused by the observed dehydration in diseased individuals as a result of frequent vomiting and laxative/diuretic abuse, and excessive exercise (Figure 5). Bulimia nervosa patients exhibit significant oral dryness (dry mouth) more frequently than controls as a direct result of reduced total fluid volume (Dynesen et al., 2008). Decreased salivary flow is also a common side effect of therapeutic anti-depression
pharmaceuticals and may be observed in individuals receiving treatment for their eating disorder or additional mental health issues (Lo Russo et al., 2007), (Milosevic, 1999).

Figure 5. Feeling of oral dryness and its relation to functionality in bulimia nervosa Patients versus controls (Dynesen et al., 2008).
Periodontal Manifestations of Eating Disorders

Inflammatory periodontal disease cause by dental plaque is the most common bacterial ailment that affects humans. Periodontal disease is triggered by varying microbiota in the oral cavity and prevails when host defense mechanisms fail to protect an individual. Eating disorder patients are at high risk for periodontal disease development due to their reduced salivary flow and various nutritional deficiencies. Oral dryness is directly related to reduction of protective aspects of saliva and the situation is worsened vitamin deficiencies (De Moor, 2004). Gingivitis and periodontitis are the two major periodontal diseases and differ mostly on their victims’ susceptible age. Gingivitis, which is the accumulation of plaque on the teeth and gums, occurs in all ages from young to old (Figure 6). Periodontitis, however, only occurs in adults (Frydrych et al., 2005). Therefore, as the highest incidence of eating disorders occurs at a relatively young age, development of periodontitis as a result of eating disorders is very uncommon. Inflammation of the gingiva resulting from improper oral hygiene is a more prevalent clinical finding in eating disorder patients and may increase the patients’ risk for potential periodontitis. Even if individuals practice proper oral hygiene, repeated binging and purging episodes discredit their oral care (Lo Russo et al., 2007).

Due to their vitamin C deficiencies, eating disorder patients are at high risk for developing scurvy. Scurvy results in improper collagen synthesis and
predisposes patients to periodontal disease, gingival swelling, and random episodes of gingival bleeding. If left untreated, advanced periodontal disease will lead to loss of dentition (Lo Russo et al., 2007).

Bulimia nervosa patients tend to have better oral hygiene habits than anorexic patients. This can be attributed to the fact that individuals with bulimia possess a more practical body image than anorexics and are careful to maintain their oral aesthetics. Anorexic Nervosa may stem from more serious psychopathology based on distorted body image and patients have been shown to have more severe gingival disease (De Moor, 2004).

**Figure 6.** Plaque accumulation and subsequent gingival inflammation (Mayo Clinic Staff, 2010).
Damage to the Oral Mucosa

The oral mucosa may be damaged by physical force as a result of constant binging and purging, due to the consummation of large quantities of food followed by the impact of vomiting. Bulimics and purge-type anorexics may also use foreign object to induce vomiting causing further agitation (De Moor, 2004).

Like many symptoms facing eating disorder patients, mucosal lesions may also be a direct result of nutritional deficiencies. Reduced bodily intake of specific essential vitamins nutrients can result in a numerous problems ranging from anemia to various metabolic changes. Specifically, vitamin B group deficiency has been shown to cause reduced turnover in epithelial cells impair regeneration of the oral mucosa. Vitamin B group deficiency manifests painfully as atrophic glossitis on the tongue while insufficient riboflavin results in bilateral presentation of angular cheilitis of the lips (Figures 7 and 8) (Lo Russo et al., 2007).

Figure 7. Atrophic Glossitis on dorsal surface of tongue (Cohen, 2004).
Angular cheilitis may also be a result of chronic infection by Candida fungi, which commonly present as oral mucosal lesions. All candida infections are initially correlated with nutritional deficiencies and may clinically imply several diseases including eating disorders, AIDS, and diabetes. Candida fungi may secondarily infect pre-existing trauma-induced mucosal lesions in eating disorder patients and infections are never found in healthy adolescents. Therefore, the clinical presence of candida should raise suspicion regarding possible disease (Frydrych et al., 2005).

Dental Erosion in Eating Disorder Patients

The most common manifestation of purge-type eating disorders is by far erosion of dentition. Enamel erosion is defined as “the loss of dental tissue without the involvement of bacteria” (Bretz, 2002). Erosion is elevated in eating disorder patients due to the constant introduction of acidity into the oral cavity.
The resulting effect is eroded anterior and posterior palatal surfaces of the maximally dentition. This pathology is referred to as perimolysis and presents as smooth, glossy dentition (DeBate et al., 2005). Typically, patients present with enamel erosion if they frequently consume large quantities of acidic fruits, carbonated beverages, sugary drinks, or suffer from gastric reflux. Bulimic patients, however, exhibit extreme erosion due to consistent self-induced vomiting episodes (Bretz, 2002).

Perimolysis may develop secondary to the constant intake of carbonated and caffeinated beverages (to increase energy) or to high levels of sports drink consumption (compulsive exercise). Eating disorder patients may also consume high levels of alcohol to either produce stomach distension or aide in vomiting induction. Additionally, patients often consume extremely acidic foods such as vinegar or fresh lemons to deplete hunger pangs. Because this type of erosion is chemically induced (as opposed to bacterial), the resulting effect is smooth, glossy, and extremely shiny dentition (Lo Russo et al., 2007). Constant regurgitation of gastric contents repeatedly lowers intraoral pH of bulimic patients to a dangerously low average of 3.8 and ultimately results in pathological enamel disintegration (Figure 11) (Bretz, 2002).
In addition to causing extreme pain, perimolysis results in raised dental restorations and heightened sensitivity to varying temperatures. Constant wear leads to exposure of damaged dentin, and advanced cases result in visibly exposed pulps. If left untreated, demineralization may ultimately result in the formation of an open bite (DeBate et al., 2005; De Moor, 2004).

Initially, it may be difficult to establish whether perimylosis is the result of acidic food consumption or intrinsic acid regurgitation. While research is conflicting, some studies have shown that extrinsic acid from dietary consumption results in labial erosion while intrinsic gastric acid results in
maxillary palatal erosion (Figure 10). However, the presentation of gastric acid regurgitation makes it difficult to distinguish causation between self-induced vomiting or chronic gastroesophageal reflux disease (GERD) (Frydrych et al., 2005), (Milosevic, 1999).

![Figure 10. Labial erosion of dentition due to high consumption of acidic foods and beverages (Meinerz, 2011).](image)

Perimolysis manifests in eating disorder patients in as little as six months, with an average onset of two years (Figure 11). Many different factors account for differing erosion rates. For example, eating disorder patients may have different oral hygiene habits that either accelerate or retard the demineralization process. Also, elevated dietary intake of acidic food in some patients will compound the effects of self-induced vomiting (Frydrych et al., 2005). While
research suggests that self-induced vomiting solely affects palatal and lingual surfaces, patients who regularly purge for more than five years will begin to exhibit labial wear as well (Milosevic, 1999).

Figure 11. Perimolysis of the palatal surfaces of maxillary dentition in a bulimia nervosa patient, complete with raised amalgam restorations (Bouquot & Seime, 1997).

Dental Caries

Current research does not unanimously agree on whether or not chronic self-induced vomiting increases the incidence of caries. Xerostomia is known to greatly increase the risk of caries formation, and its effects are exaggerated by frequently prescribed anti-depressants. Additionally, altered salivary composition
and appetite suppressants may be cariogenic. Unfortunately, the cariogenic bacteria *Streptococcus mutans* is able to adapt and survive at low pH and may thrive during weakened oral defense (Frydrych et al., 2005).

Conflicting results may be attributed to the intricate pathology of caries and the numerous factors that account for its pathogenesis. Individual susceptibility varies based on personal oral hygiene, diet, degree of malnutrition, possible genetic predisposition, and previous fluoride exposure during the dentition development (DeBate et al., 2005). Duration of vomiting episodes may also affect susceptibility, as well as level of pre-existing decay (De Moor, 2004). In certain cases, eating disorder patients may be so consumed with their outward appearance that they practice compulsive oral hygiene and reduced risk for caries formation (Milosevic, 1999).

**Osteonecrosis of the Mandible**

As previously mentioned, osteoporosis may develop within six months of amenorrhea in eating disorder patients. Bisphosphonate treatment has been proven to arrest bone demineralization and aide in increasing bone density. However, bisphosphonate induce osteonecrosis of the maxillary and mandibular bones. Osteonecrosis is seen when the maxilla and mandible are readily visible through gingival lesions (Figure 12). Therefore, in the case of eating disorder induced osteoporosis, oral health complications are secondary to systemic health treatment (Lo Russo et al., 2007).
Figure 12. Bisphosphonate induced osteonecrosis of the jaw (Ruggiero & Mehrotra, 2009).
DISCUSSION

Importance of Early Detection and Prevention by Dentists and Lack of Eating Disorder Education in Dental School Curriculum

Eating disorders can easily be hidden from family and friends because these diseases do not rapidly deteriorate outward physical appearance. Because primary implications of eating disorders present in the oral cavity, it is crucial that dentists know what to look for. Oral health care providers are often the first to observed the effects and manifestations of previously undiagnosed eating disorders and will view serious implications before any other health care professional. Dentists play a vital role in secondary prevention by practicing early detection, treatment, and halting any further advancement of the eating disorder at hand (DeBate et al., 2005; Milosevic, 1999).

Sadly, the majority oral health care professions do not screen their patients for eating disorders due to several shocking factors. First of all, current dental school graduates lack the basic training required to practice secondary prevention of eating disorders. Dentists simply do not know what to look for in terms of the manifestations of eating disorders and may overlook obvious symptoms. Second, dentists often misdiagnose the oral manifestations of eating disorders all together and start incorrect treatment for a different cause/disease all together. Dentists may also internalize any suspicion of eating disorders due
to lack of protocol or knowledge regarding proper referral and communication. Lastly, patients often deny their eating disorders and may refuse secondary prevention practices offered by their dentist. Together, these factors compromise the patient’s recovery, future mental & physical health, and proper restoration. It is vital for the dentist and patient to be honest with each other to ensure best possible outcome and treatment (Hague, 2010).

Current research indicates that dentists are unaware of their vital roles in secondary prevention of eating disorders. Out of one hundred surveyed dentists, only eleven stated that they would readily refer suspected eating disorder patients to a physician. Less twenty-eight percent of dentists recalled assessing patients for eating disorders, and only eleven percent referred suspected eating disorder patients to another health care provider. Of the dentists who screened for eating disorders, less than seventeen percent scheduled more frequent recall appointments for their eating disorder patients and only six percent actively participated in the patients recovery process (DeBate, Vogel, Tedesco, & Neff, 2006).

Gender differences among dentists also contribute to the discrepancies regarding secondary prevention. Female dentists regard eating disorders in a more severe manner than male dentists, and are more likely to engage in secondary prevention practices. Overall, more female dentists screen patients for oral implications of eating disorders and provide proper care and referral if diagnosis is made. Male dentists do not regard eating disorders as seriously as
female dentists do, and often to do recognize the importance of long-term
treatment planning and mental health care in these patients. These differences
among female and male dentists can most likely be attributed to personal
experiences. Female dentists are more likely to know someone who has been
affected by an eating disorder and the disease is more relevant to them on an
intimate level. These trends are of great interest and further research needs to be
conducted to solidify these statistics (DeBate et al., 2006).

Currently, oral health curriculum in dental schools and hygiene schools
seriously lacks focus on the oral health implications of eating disorders (Table 5).
This lack of education regarding proper assessment and referral processes
hinders secondary prevention practices and puts eating disorder patients at
elevated risk for serious systemic health implications. Dental hygiene curriculum
spends an average of fifty-two minutes on eating disorders while dental school
curriculum focuses approximately twenty-four minutes on this issue. While both
numbers are unacceptably low, it should be noted the hygiene programs spend
more than twice the time than dental programs do on the implications of eating
disorders. In addition, eighty-one percent of hygiene schools instructed proper
oral health treatment of eating disorder patients while only fifty percent of dental
schools taught proper treatment. Only forty-four percent of dental schools taught
the full oral health implications of eating disorders and highlighted the importance
of secondary prevention by oral health practitioners (DeBate et al., 2007).
It is clear that most dental school and dental hygiene programs do not adequately teach the importance of early eating disorder detection by dentists and the proper referral protocol (Table 6). Current programs downplay the magnitude of oral health implications of eating disorders and properly link oral manifestations of disease to potential systemic health deterioration. However, eating disorder related oral health education has increased since 1990. This indicates that oral healthcare providers are becoming increasingly aware of the importance of this type of education, although still significantly lacking. It is clear that current dental students and graduates are not receiving the adequate knowledge and training regarding the oral health implications of eating disorders and do are not properly equipped with treatment skills for these patients (DeBate et al., 2007).

<table>
<thead>
<tr>
<th>Program provides curriculum regarding general characteristics of:</th>
<th>Dental Programs f (%)</th>
<th>Dental Hygiene Programs f (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anorexia Nervosa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No</td>
<td>7 (29.2)</td>
<td>4 (04.4)</td>
</tr>
<tr>
<td>• Yes</td>
<td>17 (70.8)</td>
<td>86 (95.6)</td>
</tr>
<tr>
<td>• Number of minutes (m±sd)</td>
<td>32.35±27.85</td>
<td>32.67±19.94</td>
</tr>
<tr>
<td>Bulimia Nervosa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No</td>
<td>7 (29.2)</td>
<td>4 (04.4)</td>
</tr>
<tr>
<td>• Yes</td>
<td>17 (70.8)</td>
<td>86 (95.6)</td>
</tr>
<tr>
<td>• Number of minutes (m±sd)</td>
<td>33.24±27.15</td>
<td>31.80±20.26</td>
</tr>
<tr>
<td>Eating Disorders Not Otherwise Specified (EDNOS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• No</td>
<td>13 (54.2)</td>
<td>38 (42.2)</td>
</tr>
<tr>
<td>• Yes</td>
<td>11 (45.8)</td>
<td>52 (57.8)</td>
</tr>
<tr>
<td>• Number of minutes (m±sd)</td>
<td>17.27±11.48</td>
<td>22.31±21.22</td>
</tr>
</tbody>
</table>
Table 6. Views on eating disorders in dental and dental hygiene programs (DeBate et al., 2007).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Program</th>
<th>Agree f (%)</th>
<th>Neutral f (%)</th>
<th>Disagree f (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eating disorders are serious health issues.</td>
<td>Dental</td>
<td>23 (95.8)</td>
<td>0 (0.0)</td>
<td>1 (4.2)</td>
</tr>
<tr>
<td></td>
<td>Dental Hygiene</td>
<td>88 (97.8)</td>
<td>1 (1.1)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Dental professionals have a professional responsibility to identify patients with anorexia nervosa, bulimia nervosa, or EDNOS.</td>
<td>Dental</td>
<td>23 (95.8)</td>
<td>0 (0.0)</td>
<td>1 (4.2)</td>
</tr>
<tr>
<td></td>
<td>Dental Hygiene</td>
<td>89 (98.9)</td>
<td>0 (0.0)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Dental professionals have a professional responsibility to refer patients with anorexia nervosa, bulimia nervosa, or EDNOS.</td>
<td>Dental</td>
<td>22 (91.7)</td>
<td>1 (4.2)</td>
<td>1 (4.2)</td>
</tr>
<tr>
<td></td>
<td>Dental Hygiene</td>
<td>83 (92.2)</td>
<td>6 (6.7)</td>
<td>1 (1.1)</td>
</tr>
<tr>
<td>Dental professionals have a legal responsibility to identify patients with anorexia nervosa, bulimia nervosa, or EDNOS.</td>
<td>Dental</td>
<td>12 (50.0)</td>
<td>9 (37.5)</td>
<td>3 (12.5)</td>
</tr>
<tr>
<td></td>
<td>Dental Hygiene</td>
<td>60 (66.7)</td>
<td>23 (35.6)</td>
<td>7 (7.8)</td>
</tr>
<tr>
<td>Liability in identifying patients with eating disorders is an emerging health issue in dentistry.</td>
<td>Dental</td>
<td>13 (54.2)</td>
<td>8 (33.3)</td>
<td>3 (12.5)</td>
</tr>
<tr>
<td></td>
<td>Dental Hygiene</td>
<td>46 (51.1)</td>
<td>35 (38.9)</td>
<td>9 (10.0)</td>
</tr>
<tr>
<td>Liability in referring patients with eating disorders is an emerging health issue in dentistry.</td>
<td>Dental</td>
<td>12 (50.0)</td>
<td>9 (37.5)</td>
<td>3 (12.5)</td>
</tr>
<tr>
<td></td>
<td>Dental Hygiene</td>
<td>47 (52.8)</td>
<td>35 (39.3)</td>
<td>7 (7.9)</td>
</tr>
<tr>
<td>Dentists and dental hygiene students are in a high risk group for eating disorders.</td>
<td>Dental</td>
<td>6 (25.0)</td>
<td>12 (50.0)</td>
<td>6 (25.0)</td>
</tr>
<tr>
<td></td>
<td>Dental Hygiene</td>
<td>38 (42.2)</td>
<td>42 (46.7)</td>
<td>10 (11.1)</td>
</tr>
<tr>
<td>Dental school faculty have an ethical responsibility to refer students with an eating disorder for psychological counseling.</td>
<td>Dental</td>
<td>22 (91.7)</td>
<td>1 (4.2)</td>
<td>1 (4.2)</td>
</tr>
<tr>
<td></td>
<td>Dental Hygiene</td>
<td>81 (90.0)</td>
<td>8 (8.9)</td>
<td>1 (1.1)</td>
</tr>
</tbody>
</table>
Treatment

Treating anorexia nervosa and bulimia nervosa is a complex process involving many different health care providers working intimately as a team to ensure the patients recovery. Due to the medical and psychological nature of these diseases, various fields of medicine intertwine to provide their expertise. Recently, great emphasis has been placed on therapeutic effect of familial aide in treatment. AN patients exhibited higher rates of recovery and remission when their families were intimately involved in treatment. Familial involvement ensures constant monitoring of nutritional intake and detrimental physical behavior. Overall, patients whose families were involved in treatment were less likely to experience relapse (Weaver, Sit, & Liebman, 2012).

Fortunately, the oral health manifestations of eating disorders can be properly treated and restored if identified in a timely manner. Due to the mental nature of these diseases, it is of utmost importance that the dentist properly communicates with the patient to avoid the patient’s denial and treatment refusal. All conversations regarding possible eating disorders must be conducted in private and remain confidential. The oral health provider must provide emotional support and portray calm and nurturing body language (Lo Russo et al., 2007). Patients may fear judgment and disapproval from their dentists and will not initially admit to disordered eating habits. However, an empathetic and sympathetic dental approach will comfort the patient and open the gateway to remission and potential recovery (Milosevic, 1999).
The timing of dental intervention remains controversial, as there is no way to ensure the patient is actually stopping detrimental compensatory behavior. If the patient continues consistent purging after restoration has been completed, for example, then the dentition will continue to deteriorate despite the new restorations and further treatment will be needed (Milosevic, 1999).

The most important aspect of oral health treatment is to guide patients towards proper management and care (Table 7). The dentist must articulate the importance of frequent recall visits to monitor loss of dentition and soft-tissue lesions and the gravity of at home self-care while mental health care is proceeding. Dentists should provide custom trays for 1.1% neutral fluoride and instruct daily use in order to prevent further erosion and strengthen remaining enamel. In addition, patients should rinse daily with a 5% fluoride solution and be instructed to not brush teeth within one hour of vomiting (Lifante-Oliva et al., 2008). Vomiting immediately softens enamel and brushing teeth will cause harmful abrasion. Patients may instead chew sugarless gum or rinse with water or milk post-purging to refresh their oral cavity. Lastly, patients should immediately rinse their oral cavity with water apply alkaline gel to the surface of their teeth immediately post-purge in order to reduce intra-oral acidity (McCreedy, 2006; Milosevic, 1999).
Table 7. Recommendations to prevent further dental deterioration in eating disorder patients (Milosevic, 1999).

<table>
<thead>
<tr>
<th>Raise awareness of sources of acid in the diet, thus:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduce intake of acidic drinks, drink alternatives (low calorie beverages are usually consumed but they still have erosive potential)</td>
</tr>
<tr>
<td>• Reduce consumption of fresh fruit especially citrus fruit</td>
</tr>
<tr>
<td>• Alcohol in various guises eg white wine, mixers, cider, alcopops</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-vomiting methods of increasing pH and improving oral milieu:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• After self-induced (SIV) vomiting chew gum, rinse mouth with water or milk</td>
</tr>
<tr>
<td>• Rinsing with an antacid preparation</td>
</tr>
<tr>
<td>• Gentle toothbrushing with a small amount of desensitising or bicarbonate toothpaste after SIV may be safe</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Check that any medication does not provoke dry mouth or nausea</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>For salivary hypofunction/dry mouth:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Prescribe neutral artificial saliva or sialogogue pastilles eg Saliva Orthana spray and lozenges (Nycomed UK Ltd, Birmingham); Salivix pastilles (Thames Laboratories Ltd, Wrexham)</td>
</tr>
</tbody>
</table>

Eating disorder induced erosion can cause hypersensitivity and pain and must be restored to prevent further demineralization and ultimate loss of dentition. The dentist must examine interocclusal space to determine whether restoration is possible. In most cases, restoration can be performed using dentin bound composite. Composite restoration is the most favorable approach in eating disorder patients because it is not acid soluble and will not deteriorate if purging continues. In addition, damaged surfaces may be restored with porcelain veneers or resin bonded crowns to provide total coverage restoration. These adhesive treatments are reversible and appealing in eating disorder patients due to their conservative nature. Dentists may utilize these methods to provide early
restorative intervention in order to protect the remaining dentition while mental health treatment is obtained (Figures 13 and 14) (Bretz, 2002; Milosevic, 1999).

**Figure 13.** Full mouth restoration in bulimia nervosa patient (Makarita, 2009).

**Figure 14.** Full mouth restoration of eroded dentition with all amalgam restorations replaced by non-acid soluble composite (http://www.eveshamdental.co.uk/treatments/preventivecare/erosion/).
Full recovery is attainable in anorexic and bulimic patients with proper medical, dental, and psychological care. Both cases require extensive psychotherapy in conjunction with nutritional advising and monitoring (Milosevic, 1999). Remission in BN is defined as the absence of binge/purge episodes for a minimum of four weeks and recovery requires the patient to be completely free of compensatory behavior from one to twelve months. Thus, remission indicates the patient is still diseased and that detrimental behaviors may restart immediately at any point. In 1997, Field et al. found that relapsing is extremely common in bulimic women and that bulimia remission should be a period of one year and complete recovery should be noted if the patient abstains from bulimic behavior for two years (Field et al., 1997; Williams, Watts, & Wade, 2012). Bulimic patients are able to achieve full recovery (by current standards) in eighty percent of cases. In contrast, recovery in anorexia nervosa, defined by the recurrence of normal menstrual patterns and healthy weight, is attained in only fifty percent of cases (Milosevic, 1999)
Figure 15. Probability of remission in bulimia nervosa patients. Sample consisted of 86 patients who had not engaged in binge/purge episodes for a minimum of eight weeks (Field et al., 1997).
CONCLUSION

Eating disorders account for the highest rate of morbidity and mortality of any psychiatric illness among adolescents and their prevalence continues to increase. Dentists and dental hygienists have the ability to detect the early manifestations of such diseases before any other health care practitioner and their role is critical the patient’s ultimate prognosis. Early detection of symptoms such as perimolysis and soft tissue lesions will allow for early intervention and restoration, and will increase the likelihood of full recovery (Hague, 2010).

Throughout systemic and mental health treatment, it is vital for the oral practitioners to maintain intimate involvement with all physicians involved. The dentist can plan oral health treatment and intervention based on the stages of total recovery and all practitioners involved can aide each other. For example, the dentist and physician can discuss which prescribed medications are altering salivary flow and together monitor the patient’s treatment attendance. As previously mentioned, and average of eighty percent of bulimic patients are able to achieve full recovery in contrast to only fifty percent of anorexics (Milosevic, 1999).

Although thorough studies have been conducted regarding the oral health implications of eating disorders, research is still lacking on several levels. The associated of caries with self-induced vomiting must be further explored due to the conflicting nature of the current results. A more standard and comprehensive approach to this investigation can produce unanimous agreement. The role of
*Streptococcus sobrinus* as a biomarker for bulimia must also be inspected further. This bacterium has the potential to become an unarguable biomarker for self-induced vomiting and will aide dentists in diagnosis when patients deny their eating disorders. In addition, treatment options and outcomes need to be investigated further in order to establish and standard protocol for dentists to follow upon detection of the oral manifestations of eating disorders (Bretz, 2002; Milosevic, 1999).

While we already established several oral and systemic health implications of eating disorders, we must further investigate the role that dental fear may play in the severity of these symptoms. Studies indicate that eating disorder patients possess higher levels of dental fear and anxiety compared to controls, and are less likely to attend regularly scheduled dental appointments. Therefore, fear of the dentist is a compounding risk factor for oral health deterioration among eating disorder patients. The patients examined in current studies may possess less fear as they willingly and readily attended recall appointments and may not truly reflect the oral health status of most eating disorder patients. Further research is required in order to establish the true extend of oral pathology at various stages of disease as patients with increased dental fear may exhibit more severe damage to the oral mucosa (Shaughnessy et al., 2008; Willumsen & Graugaard, 2005).

In addition to simply observing oral mucosal damage with the naked eye, dentists potentially have the ability to identify nutritional deficiencies by inspecting
decreased bone density of the mandibular bones in radiographs. With further investigation and scientific support, panorex radiographs can be used as a means of diagnosis in high-risk patients (adolescent girls). Radiographs may also be used to support dentist’s suspicions of possible eating disorders if patients deny the condition and bring attention to the patients increased risk of osteoporosis. Much like biomarkers, the identification of mandibular deterioration by radiographs in eating disorder patients needs to be investigated as a means of diagnosis support (Shaughnessy et al., 2008).

Currently, research relating the importance of eating disorders in oral health curriculum is alarmingly insufficient. Dental school and hygiene program curriculums do not adequately emphasize the importance of early dental detection, nor do they properly teach the wide range of oral health manifestations. Further research must be conducted to investigate the correlation between allotted curriculum time and the quality of care graduates are able to provide to eating disorder patients (DeBate et al., 2007).

Lastly, the role of female versus male dentists in early detection must be further investigated to establish a correlation between likelihood of intervention. As previously mentioned, female dentists are more likely to assess patients for the oral implications of eating disorders and to subsequently refer them for proper treatment. Male dentists may be less sensitive to this subject and self-reported that they’re less likely to assess patients. Further investigation can explore the cause of this discrepancy and ultimately ensure that all dentists,
regardless of gender, will assess their patients thoroughly and follow proper referral procedures (Rita DiGioacchino DeBate et al., 2006).

In conclusion, anorexia nervosa and bulimia nervosa are multifactorial psychiatric disorders that require targeted attention from various angles. Oral health practitioners play a vital role in early detection and prevention of further oral and systemic deterioration and it is of utmost importance for the dental community to understand their vital role in these morbid diseases. With early detection and treatment, patients can achieve full recovery and fully restored dentition.
REFERENCES


release.net/59/Full%20Mouth%20Rehabilitation%20and%20Bite%20Management%20of%20Severely%20Worn%20Dentition.php


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ACADEMIC EXPERIENCE
Master of Arts in Medical Science, Boston University School of Medicine
January 2013
Concentration: Oral Health Sciences
Bachelor of Arts, Boston University
May 2010
Major: Biology

Diploma- Westwood High School, MA
June 2006

EMPLOYMENT EXPERIENCE

Dental Assistant, BriteSmile Inc.
Jan '08- Jan '10
- Independently performed up to 18 whitening procedures per day
- Assisted the doctor in more difficult cosmetic cases such as Invisalign and Veneers
- Developed patient communication skills by performing the majority of the consultations

Dental Patient Services Coordinator, Massachusetts General Hospital
Jan ’11 – June ‘11
- completed preliminary treatment planning
- independently generated pre-treatment estimates for patients
- processed x-rays and charting at the request of the dentists

DAT Instructor, Kaplan
Present
- Prepare pre-professional students for the Dental Admission Test
- Teach the principles of biology, chemistry, organic chemistry, quantitative reasoning, reading comprehension, and perceptual ability
- Strategize successful approaches to completing standard computerized examinations

MEETINGS ATTENDED/ACADEMIC ENRICHMENT PROGRAMS

Academy of General Dentistry
Jul '08
- Attended several student-directed meetings and gained insight into the field of dentistry

Yankee Dental Congress
Jan '09, Jan ‘12
- Attended as a member of the Boston University Pre-Dental society and again as a Master's student
- Gained knowledge and experience by interacting with exhibitors and current dental students

Project White Coat, Boston University Goldman School of Dental Medicine
Jun ‘10
- Month long enrichment program consisting of graduate level courses in Biochemistry, Anatomy, and Physiology
- Several hours of shadowing and assisting fourth year dental students