UNIVERSITY OF THE WESTERN CAPE

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Department of Paediatric Dentistry

A Comparative Study of the Oral Health Status of Cardiac and Non-Cardiac Paediatric Patients at Tygerberg Hospital

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A minithesis submitted in partial fulfillment of the requirements for the degree of Magister Scientiae in Dental Sciences in the Department of Paediatric Dentistry, Faculty of Dentistry, University of the Western Cape

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Keywords

Children

Cardiac diseases

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Bacterial endocarditis

Caries

Plaque

Gingivitis

Parental care

Parent's knowledge

Referral

SUMMARY

Introduction: Dental care in children with cardiac disease is an important consideration from the time the first tooth erupts because of the risk of bacterial endocarditis. Transient bacteraemia occurs frequently during dental procedures with instrumentation.

Aim: To determine the oral and dental health status of paediatric cardiac patients, 12 years of age and younger, and compare them with non-cardiac patients.

Objectives: (1) To compare the prevalence of dental decay, developmental enamel defects, plaque and gingivitis in the cardiac and non-cardiac group of children. (2) To assess the oral health awareness, knowledge, and practice of parents/guardian for their children by collateral data. (3) To assess parents/guardians knowledge with regard to the prevention of infective endocarditis in their cardiac child.

Materials and methods: Parents/caregivers and child pairs attending the paediatric clinics at Tygerberg Hospital were informed of and invited to participate in the study. A total of 150 children, 75 with known cardiac condition (study group) and 75 non-cardiac (control group) were examined. The study and control groups were matched for age and gender. The following information was recorded: the type of cardiac disease, the visible plaque deposits, gingivitis, and tooth status (dmft, DMFT and developmental enamel defects). Teeth were examined using the World Health Organization's (WHO) guidelines for Basic Oral Health Surveys (1987). No radiographs were taken. Dental plaque was visually inspected on the labial surfaces of maxillary incisors by using the criteria recommended by Spitz et al (2006). The gingivitis was recorded simply as healthy and inflamed.

Results: No statistically significant differences were established in the study between the caries experience score for the cardiac and control groups. However, the mean decayed component and total mean dmft and DMFT were slightly higher *(dt= 2.67 vs. 2.01 and DT= 0.43 vs. 0.29)* in the cardiac group in both the primary and permanent dentitions. The mean missing and filled teeth were slightly higher *(mt=0.68 vs. 0.99)* in control group as compared to cardiac but these results were not statistically significant. The levels of developmental dental anomalies were slightly higher in the cardiac group but not statistically significant *(p = 0.27)*. The gingival inflammation was higher in the cardiac as compared to control (p = 0.04) group.

Conclusion: There is no significant difference in the caries experience between the cardiac and control groups. The cardiac group generally has a higher decay component and a lower missing component which may be an indication of the lack of dental intervention. The gingival inflammation was significantly higher in the cardiac group, although the plaque scores were similar in the two groups.

DECLARATION

I hereby declare that "A comparative study of the oral health status of the cardiac and non-cardiac paediatric patients at Tygerberg Hospital" is my own work, that it has not been submitted before for any degree or examination in any university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Sobia Zafar

February 2008

Signed:……

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DEDICATION

24 SEPTEMBER 2007

This work is dedicated to my husband, Allauddin, for the tremendous sacrifices he has made, the unconditional love he has shown, the unwavering support he has offered and the sparkling enthusiasm he has displayed throughout.

This work is also dedicated to my son, Mustafa, who had to endure many hours apart while I concentrated on this study.

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CHAPTER 1

INTRODUCTION

The heart is an organ of complex anatomy and its essential function is pumping oxygenated blood to the brain and vital organs. Heart diseases can be divided into two main groups, congenital and acquired heart diseases. Children with congenital or acquired heart defects occurs approximately eight in 1000 live births (Scully and Cawson, 1987). Congenital heart diseases, also called congenital cardiovascular defects (CCD) occurs in approximately 32,000 to 35,000 children born per year nationally, making heart defects the most commonly occurring birth defect (American Heart Association [AHA], 2000). Affected children require special care in dentistry because of the susceptibility to infective endocarditis from oral infections.

There are approximately 35 types of recognized heart defects occurring alone or in combination, ranging in severity from haemodynamically insignificant to extremely complex and life threatening. There may be genetic or environmental situations that can affect the development of the heart defects. In the majority of cases the cause is considered multifactorial, with no specific identifiable trigger. Significant improvements in diagnosis, medical management and surgical treatment in the USA, reduce the death rate of CCD over the period 1987–1997 by approximately 23%, with actual deaths decreasing approximately 16% (AHA, 2000).

Congenital heart disease can be cyanotic or acyanotic and can predispose to infective endocarditis (IE). Cyanotic congenital heart

defects ('blue babies') are more severe defects as compared to other heart defects, they can be lethal and life threatening and lead to cardiac failure. In cyanotic heart defects, there is right to left shunting. There are different types of cyanotic and acyanotic congenital heart diseases which are shown in the Table 1.1 below. The causes of congenital cardiovascular defects (CCD) are mostly unknown. The main acquired causes are congenital rubella or cytomegalovirus infection and maternal drug misuse. The best known genetic cause is Down's syndrome but there are many others like Marfan's syndrome, Ehlers-Danlos syndrome, Turner syndrome etc. The main cause of acquired childhood heart diseases is Kawasaki's disease and Rheumatic fever (Scully and Cawson, 2005).

Table 1.1- Main forms of Congenital Heart Diseases are:

CYANOTIC	ACYANOTIC
Transposition of great vessels	Ventricular septal defect
Tetralogy of Fallot	Arterial septal defect
Eisenmenger's syndrome	Patent ductus arteriosus
Tricuspid atresia	Coarctation of aorta
Pulmonary atresia	Pulmonary stenosis
	Mitral valve prolapse
	Aortic stenosis
	Bicuspid aortic valve

The World Health Organization Regional Office for Africa [WHO, 2005] reported the current status of cardiac disease in the African region. It is noted with concern that the burden of cardiac disease is rapidly increasing in Africa. It is regarded as a public health problem throughout the African region but only few prevalence studies on congenital cardiovascular defects (CCD) in children and adolescents are published. Cardiovascular diseases (CVD) are the main noncommunicable diseases and are major public health concerns worldwide. According to The World Health Report (2001), cardiovascular diseases accounted for 9.2% of the total deaths in the African Region in 2000 compared with 8.15% in 1990.

Rheumatic heart disease was and is the most important form of acquired cardiovascular diseases in children and adolescents in Africa. Several studies show the prevalence of rheumatic heart disease ranged from 15-20 per 1000 population (Longo-Mbenza et al., 1998; Amoah and Kallen, 2000). Of the 18 million people currently affected by rheumatic fever or rheumatic heart disease in the African region, two thirds are children between 5 and 15 years of age. There are about 300 000 deaths each year, with 2 million people requiring repeated hospitalization and 1 million likely to require surgery in the next 5 to 20 years.

One of the most challenging situations in the African region is the double burden of diseases. Africa is plagued with a persistently high burden of infectious diseases while experiencing a rapid emergence of noncommunicable diseases (NCDs). There is a misconception that investing in prevention and control of cardiovascular and other noncommunicable diseases would detract from the top-priority of communicable diseases in the Region. As with other NCDs, CCDs are often not given the attention they deserve as major causes of mortality and morbidity. As a result, most countries do not have

national programmes or strategies to address CCDs, and health systems are inadequate to deal with chronic diseases.

Marijon et al., (2006) in their study of CCD patients in Mozambique showed the evidence of the scarce medical facilities in Africa. The majority of the children with congenital heart disease have never been seen by a medical doctor. Early detection of cardiac disease in children is important in order to prevent serious complications and to institute endocarditis prevention.

Infective endocarditis remains an important cause of morbidity and mortality in children with cardiovascular disease. Primary prevention of endocarditis whenever possible is very important. Studies have shown significant findings regarding the paediatric patients susceptible to infective endocarditis and oral health. Poor oral health and certain dental procedures are risk factors for patients who are susceptible to infective endocarditis (Olderog-hermiston et al., 1998). Other findings include: low patient and parent awareness of preventive measures for oral health; an increased incidence of untreated dental caries; a tendency for developmental enamel defects; and inconsistent dental care due to lack of recognition of the need (Longman and Martin, 1993; Cetta et al., 1993; Franco et al., 1996).

The purpose of this study was to investigate the oral health status of children with heart disease. The motivation for the study comes from the empirical observation of the high prevalence of caries, gingivitis and poor oral hygiene among paediatric cardiac patients seen at Tygerberg Academic Hospital. The results will assist in planning an appropriate preventive oral and dental health programme for children with cardiac disease.

CHAPTER 2

LITERATURE REVIEW

2.1- Introduction

Oral and dental health is a desirable component of child health maintenance. In children with heart disease, the increased susceptibility to infective endocarditis places the child's health in great jeopardy when dental or periodontal disease is not controlled.

Dental care in children with heart disease is an important consideration from the time the first tooth erupts because of the risk of bacterial endocarditis. Transient bacteraemia occurs frequently during dental procedures with instrumentation. Preventive dental care, including good oral hygiene and regular dental visits is important to ensure a healthy mouth, thereby eliminating the need for extractions (Smith, 2001).

Despite these children being "at risk" from dental disease, many are apparently not given oral hygiene instruction, dietary counseling or advice on the use of fluoride supplements (Hobson and Slattery, 1984). Some dental practitioners seem unwilling to treat children with heart defects and there is a lack of specially trained personnel to whom they may be referred (Goodman, 1981).

The most important consideration in planning dental care for children with cardiac disease is the prevention of dental disease. As soon as the child is diagnosed as having a significant cardiac problem they should be referred for dental evaluation and an aggressive preventive

regimen should be implemented. This should include dietary counseling, fluoride therapy, fissure sealants and oral hygiene instruction (Welbury, 1997).

2.2- Definitions and terminology:

Dental Caries

Dental caries is a bacterially based disease. When it progresses, acid produced by bacterial action on dietary fermentable carbohydrates diffuses into the tooth and dissolve the carbonated hydroxyapatite mineral—a process called demineralization. Pathological factors including acidogenic bacteria (mutans streptococci and lactobacilli), salivary dysfunction and carbohydrates are related to caries progression. Protective factors which include salivary calcium, phosphate and proteins, salivary flow, fluoride in saliva, and antibacterial components and agents, can balance, prevent or reverse dental caries (Featherstone, 2000).

Plaque

Dental plaque is a tenacious microbial deposit which forms on the hard-tissue surfaces of the mouth, comprising living, dead and dying bacteria and their products, together with host compounds mainly derived from saliva (Samaranayake, 2002).

Gingivitis

Gingivitis is characterized by inflammation of the gingival tissues with no loss of attachment or bone. It occurs in response to the bacteria that live in biofilms at the gingival margin and at the sulcus. The clinical signs of gingivitis include erythema, bleeding on probing and edema. It is a reversible disease (Pinkham et al, 2005).

Congenital cardiovascular defects

Congenital cardiovascular defects (CCD), also known as congenital heart defects, are structural problems arising from the abnormal formation of the heart or major blood vessels. At least 15 distinct types of congenital defects are recognized, with many additional anatomical variations.

Defects range in severity from tiny pinholes between chambers that are nearly irrelevant and often resolve spontaneously, to major malformations that result in fetal loss or death in infancy or childhood. The common complex defects include

- Tetralogy of Fallot (9-14%)
- Transposition of the great arteries (10-11%)
- Artriovascular septal defects (4-10%)
- Coarctation of the aorta (8-11%)
- Hypoplastic left heart syndrome (4-8%)
- Ventricular septal defects (VSDs), the most common defect. Many close spontaneously, but VSDs still account for 14-16 percent of defects requiring an invasive procedure within the first year of life. (American Heart Association, 2007).

- *Congenital heart anomalies* are marked deviations from the normal standard, especially as a result of congenital defects.

2.3 - Relationships between the oral cavity and overall health

The status of the mouth is significant for children, whether they are healthy or ill. The mouth is the portal for nutrition and a source of communication. Both of these functions affect growth and development. A diseased mouth compromises its role in the normal growth and development of the individual and in its daily function. Research (Beck et al, 1996) has identified relationships between the oral cavity and overall health. It was suggested that impaired oral health can affects the normal functions of the oral cavity thus affecting the overall health (Casamassimo, 2000).

2.4 - Cardiac diseases in children:

Congenital heart disease is one of the most common developmental anomalies in children occurring in approximately 1% of live births. Congenital defects become clinically apparent at birth, in infancy, in early life or remain asymptomatic most of the individual's life and are recognized only later in life (Nadas, 1984; Radford, 1989).

Few studies have reported on the prevalence of congenital heart disease in children and adolescents in Africa. A survey conducted by cardiologists in Mozambique provided an opportunity for assessing the prevalence of congenital cardiovascular defects (CCD) in children of six public schools in Maputo (Marijon et al., 2006). They found that CCD is as common in the Southern African Black community as in Caucasians.

2.5-Oral and dental abnormalities associated with congenital heart diseases:

Scully and Cawson (2005) suggested the following oral and dental abnormalities may be associated with congenital heart diseases: delayed eruption of both the dentition, greater frequency of positional anomalies, enamel hypoplasia. The teeth often have a bluish-white 'skimmed milk' appearance and there is gross vasodilatation in the pulps. They suggested that there is greater caries and periodontal disease activity. The probable reason could be poor oral hygiene and lack of dental attention. In some of these patients, after cardiotomy, transient small white, non-ulcerated mucosal lesions of unknown etiology can also develop.

2.6 - Oral health of paediatric cardiac patients

Uzark et al (1983) and Casamassimo (2000) showed that children with cardiac diseases have higher levels of caries, plaque, and gingivitis higher than the general population. In addition, the cardiac group has a higher level of untreated caries, exposing them to open infection. It was suggested that children with CCD need to be targeted by dental health care professionals and require additional oral health promotion efforts.

In spite of the significance of heart disease in dental management, little previous research has been conducted on the oral health of affected individuals in South Africa (Marijon, 2006). Affected children require special dental care because of their susceptibility to infective endocarditis from oral infections.

Hallett et al (1992) investigated 39 children with CCD and 33 healthy control siblings at the Prince Charles Hospital in Brisbane, Australia. They found that the CCD children generally have poorer oral health compared with control siblings. This was particularly evident in the primary dentitions where there was significantly greater number of teeth with untreated dental decay. There was a direct relationship with chronic medication intake and the tooth decay, and twice as many children with CCD had developmental enamel defects, compared with controls.

In a study of children with cyanotic heart disease, acyanotic heart disease and healthy controls, Berger (1978) found that cyanotic children had more actively carious teeth and lowest level of treatment. There was a much higher prevalence of premature loss of primary teeth among children with congenital heart disease as well as enamel hypoplasia and periodontal disease, compared with healthy children.

In a case report of a young child with Tetralogy of Fallot, Rockman (1989) showed an increased presence of enamel hypoplasia and dental neglect. Bell et al (1990) carried out a study on paediatric patients with Tetralogy of Fallot, showed a high prevalence of facial dysmorphism in these patients. [The word dysmorphic describes faulty development of the shape or form of an organism. Facial features in a child are frequently referred to as dysmorphic when they vary from what is normal (Pinkham et al, 2005)].

Franco et al., (1996) in United Kingdom carried out a case-control study. He investigated the dental and gingival health of the children with severe congenital cardiac defects. They found no significant difference between the two groups for caries, developmental enamel

defects, number of sites covered with plaque or gingival inflammation. In their study, nineteen percent of the children with congenital heart diseases had never visited the dentist. This means that these children had never received any preventive dental advice or treatment.

Blicks et al., (2004) carried out a case –control study in Sweden to assess the oral health status and dental treatment record of the children with congenital heart diseases and compared them with the non-cardiac children. He found out that the children with CCD had significantly more caries in their primary teeth than the control group. The children with CCD in Sweden had been offered more caries intervention than healthy children, but the care had been given when caries were already present in spite of the system where all parents are offered a comprehensive dental care for their children from an early age with a strong caries–preventive approach. Common experience are that many children do not turn up at early dental check ups because of illness or because they were in hospital.

2.7-Parental dental attitudes knowledge and health practice:

Lowry et al (1996) in England compared dental attitudes, knowledge, and health practice between a CCD group and a matched control group. In this study, 18% of the children with CCD had not received dental care. Jowett and Cabot (2000) noted that many dentists were not confident in treating children with CCD. This lack of experience regarding these children's medical conditions and pharmacological regimes is cause for concern and suggests a need for specialist dental care for these children.

Uzark *et al.*, (1983) from United States surveyed 499 families in outpatient settings, 215 children with congenital heart diseases and 284 control children without known chronic illness. They reported the reason most often cited for the absence of dental care by the parents of children with heart disease was lack of recognition of their child's need for dental services. He surveyed 499 families in outpatient settings. Data were collected on 215 children with heart disease and 284 control children without chronic illness.

Results showed that among the children over 3 years of age with heart diseases, 29% had not received routine dental care within the past year compared with 23.4% in the controls. The parents of children with heart diseases were found to pay less money out-of-pocket for their child's health care than the parents of children in the control group.

Report by Saunders (1997) about two large paediatric centers in UK had shown disappointingly poor levels of oral health and oral health practices in the families of the cardiac group when compared with a control group of healthy children. Eighteen percent of the children with cardiac disease had never visited a dentist and 21% had never or hardly even brush brushed their teeth.

Early detection of these cardiac diseases in children is important in order to prevent serious complications and to institute endocarditis prevention (Scully and Cawson, 2005). But the above studies suggest that there is inadequate parent education regarding the preventive dental healthcare needs of children with cardiac diseases. The child's cardiac disease is such an overwhelming priority for the parent, the paediatric cardiologist, and the primary healthcare

provider, that other equally important healthcare needs may be neglected or ignored.

2.8 - Infective endocarditis (IE):

Infective endocarditis (IE) is a microbial infection of the endocardial surfaces usually involving the cardiac valves but can occur on septal defects or mural endocardium. The infection develops when micro-organisms form a transient bacteraemia, adhere to and colonize endocardial vegetation. Endocardial vegetation is initially sterile, is composed of fibrin and platelets. An abnormality of the surface endothelium appears to be necessary for the formation of vegetations. The initial damage to endothelium is probably initiated by blood jet streams and eddy currents caused by various congenital and acquired endocardial lesions (Longman and Martin, 1993).

The condition, infective endocarditis is relatively uncommon with a prevalence of 11 to 50 cases per million population per year (Young, 1987). There is evidence that there is rise in the incidence of IE in the paediatric age group. Infective endocarditis can affect the children at any age but approximately one half of the children with IE are 10 years of age or older (Johnson and Rhodes, 1982).

Certain dental procedures are associated with bacteraemia, although the magnitude will vary. Poor oral health, especially periodontal status, is an important risk factor for IE. Gingival inflammation correlates positively with the prevalence and magnitude of bacteraemia (Guntheroth, 1984). Prevalence of such bacteraemia is frequently blamed for infective endocarditis. Prevalence of bacteraemia associated with dental procedures and oral activities is shown in the Table 2.1 below.

Table 2.1- Prevalence of bacteraemia associated with dental procedures and oral activities (Seymour et al, 2000).

Procedure	Prevalence of bacteria
Extraction	
- single	51%
- multiple	68-100%
Periodontal surgery	
- flap procedure	36-88%
- gingivectomy	83%
Scaling and root planning	8-80%
Periodontal prophylaxis	0-40%
Endodontics	
- intracanal instrumentation	0-31%
- extracanal instrumentation	0-54%
Endodontic surgery	
- flap reflection	83%
- periapical curettage	33%
Tooth brushing	0-26%
Dental flossing	20-58%
Interproximal cleaning from toothpicks	20-40%
Irrigation devices	7-50%
Chewing	17-51%

Antibiotic prophylaxis is defined as the use of antibiotics to prevent infection. Infection occurs when there is a significant quantitative and qualitative bacterial insult. Appropriate antimicrobial treatment greatly improves the prognosis of infectious disease (Peterson et al, 1990).

There is a need for antibiotic prophylaxis to prevent infective endocarditis when dental procedures are undertaken on the patients who are at risk. There are several guidelines for the use of antibiotic prophylaxis in a cardiac patient; the guidelines and the antibiotics regimens are given below in the Table 2.2, 2.3 and 2.4.

Table 2.2- British Society of Antimicrobial Chemotherapy (BSAC): guidelines for antibiotic prophylaxis (www.bes.com/library).

Conditions predisposing to risk of infective endocarditis

- History of infective endocarditis
- Ventricular septal defect
- Patent ductus arteriosus
- Coarctation of the aorta
- Prosthetic heart valves
- Rheumatic and other acquired valvular disease
- Surgical constructed systemic-pulmonary shunts
- Persistent heart murmur
- Atrial septal defect repaired with a patch
- Hypertrophic cardiomyopathy
- Marfan's syndrome

Patients not at risk from infective endocarditis

- After coronary by-pass surgery
- Six months after surgery for:
  - Ligated ductus arteriosus
  - Surgically closed atrial or ventricular septal defects (without Dacron ® patch)
  - Isolated secundum atrial septal defect

Special risk patients

- Those with a previous history of infective endocarditis
- Those that require a general anaesthetic and have a prosthetic heart valve, are allergic to penicillin or who had had penicillin more than once in the previous month (Seymour et al, 2000).

Table 2.3-American Heart Association Guideline for Antibiotic Prophylaxis (JAMA, June 11, 1997- vol 227, no. 22)

Cardiac conditions associated with endocarditis

High risk category

- Prosthetic heart valves, including bioprosthetic and homograft valves
- Previous bacterial endocarditis
- Complex cyanotic congenital heart disease (e.g. single ventricle states, transposition of the great arteries, tetralogy of Fallot.
- Surgically constructed systemic pulmonary shunts or conduits

Moderate risk category

- Most other congenital cardiac malformations
- Acquired valvular dysfunction (e.g. rheumatic heart disease)
- Hypertrophic cardiomyopathy
- Mitral valve prolapse with valvular regurgitation and/or thickened leaflets

Negligible-risk category (no greater risk than the general population)

- Isolated secundum atrial septal defect
- Surgical repair of atrial septal defect, ventricular septal defect, or patent ductus arteriosis (without residue beyond 6 months)
- Previous coronary artery by-pass graft surgery
- Mitral valve prolapse without valvular regurgitation
- Physiologic, functional or innocent heart murmurs
- Previous Kawasaki disease without valvular dysfunction
- Previous rheumatic fever without valvular dysfunction
- Cardiac pacemakers and implanted defibrillators

Table 2.4 -Antibiotic Regimens (AHA) (Seymour et al, 2000 and 2002)

Standard general prophylaxis

Adults: Amoxycillin 2 g

Children: Amoxycillin 50mg/kg Orally 1 hour before procedure

Unable to take oral medications

Adults: Ampicillin 2g iv or im

Children: Ampicillin 50mg/kg im or iv within 30 minutes before procedure

Allergic to penicillin

Adults: Clindamycin 600mg

Children: Clindamycin 20mg/kg 1 hour before procedure

Or

Adults: Azithromycin or Clarithromycin 500mg

Children: Azithromycin or Clarithromycin 15mg/kg orally 1 hour before surgical procedures for which antibiotic prophylaxis is recommended.

Allergic to penicillin before procedure and unable to take oral medication

Adults: Clindamycin 600 mg iv or im

Children: Clindamycin 20 mg/kg iv within 30 minute

Antibiotic prophylaxis is not required for all dental procedures but in any procedure where there is a risk that it can breech the integrity of the gingiva, the antibiotic prophylaxis is recommended. Dental procedures which require antibiotic prophylaxis are given below in the Table 2.5.

2.5- Dental Procedures for which Antibiotic Prophylaxis is recommended to prevent Infective Endocarditis (AHA Recommendations)

- Dental extractions
- Periodontal procedures, including surgery, scaling, root planning, probing periodontal pockets and recall maintenance
- Dental implant placement and re-implantation of avulsed teeth
- Endodontic (root canal) instrumentation or surgery beyond the apex
- Subgingival placement of antibiotic fibers or strips
- Initial placement of orthodontic bands, but not brackets
- Intra-ligamentary local anaesthetic injections
- Prophylactic cleaning of teeth or implants where bleeding is anticipated
- Incision and drainage or other procedures involving infected tissues.

2.9-Parental knowledge of their children's heart condition and prophylaxis against endocarditis:

Various researchers in their separate studies discussed the parent's knowledge about their children's heart condition and prophylaxis against endocarditis (Cetta et al., 1993; Tamimi, 1998; Barreira et al., 2002; Wierzbicka, 2002).

Cetta et al. carried out a study in Maywood, Illinois. Parents of 135 children attending a paediatric cardiology clinic at the University center were posted an eight-question survey, pertaining to their knowledge of their child's cardiac disease, medications and bacterial endocarditis prophylaxis. Fifty two (62%) respondents correctly defined bacterial endocarditis. Eighty two (98%) parents knew the correct name of their child's cardiac condition. Only 56% parents of at-risk patients knew measures to prevent endocarditis. Many parents were familiar with their child's heart disease but parental knowledge of endocarditis and bacterial endocarditis prophylaxis was limited.

They concluded that intensified education and awareness programs are needed in order to prevent potential major morbidity and mortality for paediatric patients with heart diseases. They suggested the children with CCD to wear medalert bracelets alerting health professionals to their need for prophylaxis.

The children with cardiac diseases require the same comprehensive primary care as any other children. The importance of good dental health is often not realized nor explained to children or their parents and there is a need for continuous education of patients and their parents by dental specialists, physicians and nursing staff.

Olderog-Hermiston (1998) carried out a brief closed-ended survey. This survey was sent to all Paediatric department chairs in the continental USA to assess preventive infective endocarditis practices related to oral health in paediatric cardiology clinics. The respondents were asked to indicate if they were providing oral health education or oral screening; the survey asked if it would be beneficial to implement this in the paediatric cardiology clinic.

Results indicated that only a small number of paediatric cardiology clinics were providing oral health education and screening to their patients susceptible to infective endocarditis. They concluded that thorough oral management as a part of the supportive care program in cardiology clinics should be carefully considered using the combined efforts of medical professionals, ancillary staff, the patient, and family.

CHAPTER 3

AIMS AND OBJECTIVES

3.1– AIM:

To investigate the oral and dental health status of children aged 12 years and younger, with and without cardiac disease.

3.2– OBJECTIVES:

1. To determine the oral and dental status of patients 12 years of age and younger, with cardiac disease attending the Paediatric cardiac clinic at Tygerberg Hospital.

2. To determine the oral and dental status of patients 12 years of age and younger, without cardiac disease attending the Paediatric clinics for minor illnesses at Tygerberg Hospital.

3. To assess the oral health awareness, knowledge, and practice of parents/guardian for their children by collecting the collateral data through a questionnaire.

4. To assess the parents'/guardians' knowledge with regard to the prevention of infective endocarditis in their children.

3.3- RATIONALE:

van Wyk and van Wyk (2004) carried out a Oral Health Survey in South African Region. They found a high decay component in Africa. Their results were based on the Unmet Treatment Need Index and they concluded that the caries lesions in more than 80% of the children were not treated.

The motivation for this study comes from a perceived high prevalence of oral and dental diseases among paediatric cardiac patients attending the dental clinics at Tygerberg Hospital and limited previous research on it.

CHAPTER 4

MATERIALS & METHODS

4.1- Study design

This study was a comparative study of the cardiac and non-cardiac paediatric patients attending Tygerberg Hospital.

Quantitative and qualitative information of the patient's oral health was recorded on the data capture sheet (Appendix 1).

A structured questionnaire was administered by the examiner to the accompanying parent/guardian in an interview format (Appendix 2).

4.2- Population and Sample size

A selective non-random sample of 150 children, seventy-five children with known heart diseases attending the cardiac clinics at Tygerberg Hospital and seventy-five without cardiac disease (children in hospital with minor illnesses but otherwise healthy) 12 years of age and younger were selected.

4.3- Inclusion criteria

1. Children 12 years of age and younger, with any form of diagnosed cardiac disease attending the Paediatric Cardiac Clinic of Tygerberg Hospital were included in the study.

2. For each child with a heart disease (cardiac group), a healthy child (control group) of similar age, sex and race attending routine clinics at Tygerberg Hospital were examined.

Control group:

Children in the control group were those who were in the hospital for minor complains like cough, flu, fever, gastroenteritis or traumatic injuries. But there were no chronic illnesses or syndromes.

4.4- Exclusion criteria

1. Severe medically/ physically/intellectually compromised children

2. Children with other serious medical diagnoses.

3. Edentulous children.

4. Children refusing examination.

5. Parents not agreeing to be part of the study.

4.5- Ethical considerations

The proposal was presented to the Research and Ethics Committee of the University of the Western Cape for approval. Participation in this study was on a voluntary basis. Parents (father, mother, or care givers) were adequately informed about the objectives of the study. Older children's (from 6 to 12) verbal approval was also obtained for the oral examination. In younger children compliance with the oral examination was obtained through parents or caregivers. Written information and consent was provided to the accompanying parents/guardians. In case of illiterate parents/guardian or if there was any language problem, verbal information or translation was provided.

The child patients with any dental problems were referred for further dental treatment. All clinical data was used with discretion and confidentiality. No clinical files left the institution. All personal patient information was kept confidential. The rights of patients were protected at all times. Any child patient at any time could withdraw from the study. Refusal to participate in the study did not prejudice any dental referral or treatment the child required.

4.6- Data collection

The cardiac study group children were examined in the cardiac clinic at Tygerberg hospital. The child's demographic data, the type of cardiac disease, antibiotics prophylaxis and the chronic medication intake were obtained from the hospital records.

The control children were examined in the paediatric outpatient, orthopedic and surgical clinics at the Tygerberg Hospital. The child's demographics were obtained from the hospital records.

The questionnaire (Appendix 2) was administrated by the examiner at the time of child's dental examination. The parents were asked to complete a questionnaire in order to assess parental oral health awareness, practice of oral health for their children, and steps for the prevention of endocarditis.

4.7- Clinical examination

The examination was carried out in the paediatric clinics of the Tygerberg Hospital. The cardiac patients (study group) were examined at the paediatric cardiac clinic. The healthy children (control group) were examined at the paediatric outpatient, orthopedic and surgical clinics of the Tygerberg hospital.

4.7.1- Teeth:

The dental examination of children was conducted using the World Health Organization's (WHO) diagnostic criteria as enumerated in the guidelines of Basic Oral Health Surveys (1987) [Appendix 4].

Teeth were examined using the dental mirror under visible light. The tooth status [Decayed/missing/filled (dmft/DMFT) and developmental enamel defects] were recorded. No radiographs were taken.

4.7.2- Developmental Enamel defects:

Commission on Oral Health, Research and Epidemiology. FDI: An epidemiological index of developmental defects of dental enamel, DDE Index (1982) was used for recording enamel defects. [Appendix5]

4.7.3- Plaque:

Dental plaque was visually inspected on the labial surfaces of maxillary incisors by using the criteria recommended by Spitz et al (2006). It was recorded as (0) no plaque, or (1) plaque present. In cases where these teeth were absent, the plaque on maxillary canines and mandibular incisors was recorded.
This criteria was used because the examination was carried out in the hospital setting under visible light. Normally if the plaque is present on anterior teeth, it is present on other segments as well. The other reason for the selection of this criteria was that the study included the examination of children starting from one year, in these unco-operative children this method gave good results.

4.7.4- Gingivitis:

The gingivitis was recorded simply as healthy, inflamed and cyanosed. [Healthy (normal pink in color and stippled), inflamed (red, swollen or bleeding) and cyanosed (whitish or bluish)].

4.7.5- Questionnaire:

A structured questionnaire [Appendix 2] was completed by interviewing the parent or caregiver. The questionnaire consisted of ten open and closed end questions. The information collected was on the oral health awareness and practices for the children. Fluoride awareness of parent and infective endocarditis prevention were also analyzed.

4.8 – Data analysis

The data was tabulated on an excel spreadsheet and was analyzed using a commercially available Statistical Software Package (SPSS 15.0 [May 2007], SPSS Inc.).

The Mann-Whitney U test was employed to assess the significance of differences between the study and control groups for dt, mt, ft, dmft, DT, MT, FT and DMFT, and for plaque and gingivitis. The parents' attitudes and beliefs towards dental health were analyzed using chi-square test and Fisher's exact probability test. Multiple regression analysis did not elicit any meaningful results.

4.9 - Calibration

The examiner was calibrated by an experienced paediatric dentist for the clinical examinations. The calibration was a double examination of 25 children. The Cohen's Kappa coefficient was .911 for the plaque, 1.00 for gingivitis and for dmft it was .913 which is almost perfect.

Table 4.1- Showing the labels assigned to the corresponding ranges of Kappa values.

Cohen's Kappa coefficient	Strength of Agreement
<0.00	Poor
0.00 – 0.20	Slight
0.21 – 0.40	Fair
0.41 – 0.60	Moderate
0.61 – 0.80	Substantial
0.81 – 1.00	Almost perfect

All the teeth of sample were examined for caries, plaque, gingivitis and developmental enamel defects. On the advise of the statistician only these teeth were used for statistical purposes for inter and intra-examination calibration.

Table 4.2: Kappa values for the Inter-examination calibration.

Tooth No./type	kappa
55	.839
53	.896
64	.920
75	.905
73	1.00
84	.918
Mean dmft	.913
Plaque	.911
Gingivitis	1.00
Enamel defects	1.00

Intra-examiner calibration:

To ensure reliability of the results the examiner re-examined 20 children of the sample after half an hour after their first examination. And the Cohen's Kappa coefficient was for the dmft was 1.00. For the plaque was 1.00 and for the gingivitis was also 1.00, as shown in the Table 4.2 given below.

Table 4.3: The kappa coefficient for the intra-examiner calibration.

Tooth No. /type	kappa
55	1.00
53	1.00
64	1.00
75	1.00
73	1.00
84	1.00
Mean dmft	1.00
Plaque Presence	1.00
Gingivitis	1.00

CHAPTER 5

RESULTS

5.1 – Demographic distribution:

A total number of 150 patients, 75 with cardiac disease and 75 without cardiac disease as controls with a mean age of 6.5 ± 3.8 were examined for the study.

Of the seventy- five, forty (53%) subjects were male; thirty five (47%) subjects were females in both the cardiac and control groups. Age frequency of the cardiac and control groups are shown in the Table 5.1 below:

Table 5.1- Age sub-groups for the cardiac and control groups

Age (years)	Cardiac group	Control group	%
1-6 (primary)	35	35	46.6
7-12 (permanent)	40	40	53.3
Total	75	75	100

5.2 –Medical diagnosis of cardiac group:

The medical diagnosis of the cardiac patients is given in Table 5.2. Amongst them the most common were Ventricular septal defects (VSD= 32%), atrial and ventricular septal defects (AVSD = 10.7%) and atrial septal defect (ASD = 9.3%), which makes it almost 52% of the cardiac group.

Table 5.2- Medical diagnosis of the paediatric cardiac patients examined

Diagnosis	n	Percentage
Congenital heart diseases		
Ventricular septal defect (VSD)	24	32%
Atrial ventricular septal defect (AVSD)	8	10.7%
Atrial septal defect (ASD)	7	9.3%
Patent ductus arteriosus	6	8%
Tetralogy Of Fallot	6	8%
Coarcatation of aorta	1	1.3%
Congenital heart block	1	1.3%
AVSD, Infective endocarditis	1	1.3%
Mitral value prolapse	2	2.6%
Pulmonary stenosis	1	1.3%
Aortic stenosis	1	1.3%
Congenital valvular defect	1	1.3%
Truncus arteriosus	1	1.3%
Pulmonary atresia and atrioseptal defect	1	1.3%
Acquired heart diseases		
Kawasaki disease	3	4.0%
Rheumatic heart disease	11	14.6%
Total	75	100.0%

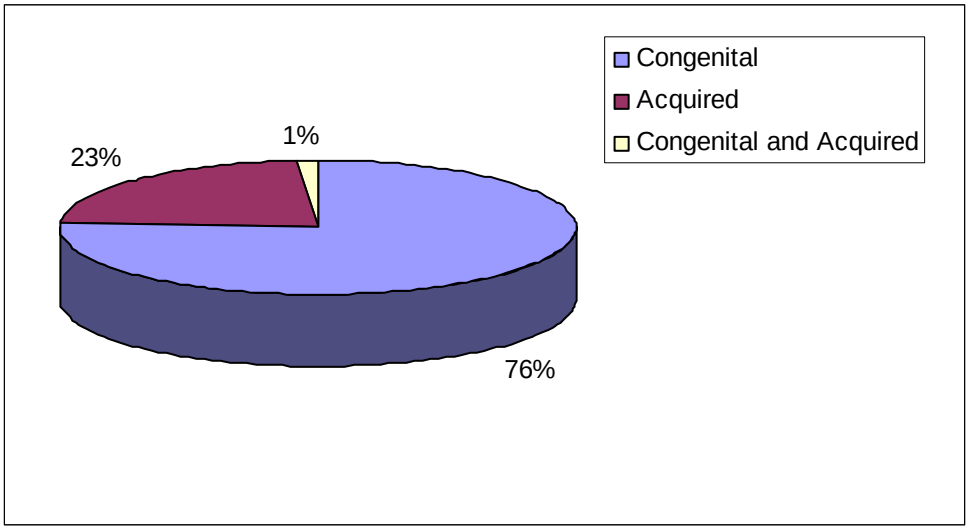

Figure 5.1- Frequency of different types of congenital and acquired conditions

5.3- Control group:

Children in the control group were those who were in the hospital for minor complains like cough, flu, fever, gastroenteritis or traumatic injuries. But there were no chronic illnesses or syndromes.

5.4 - Dental caries:

The mean number of decayed, missing and filled teeth in the primary dentition (dmft) was slightly higher in the CCD group compared with the control group (3.7 vs. 3.4, p = 0.84), but this difference was not statistically significant. By contrast, in the permanent dentition, no significant differences were obtained in the mean DMFT between the cardiac and control groups (0.6 vs. 0.6, p= 0.84).

Table 5.3- Caries experience in the cardiac and control groups

Caries experience	Cardiac=75	Control=75	P value
- dmft - dt - mt - ft	3.7 ± 4.3 2.67 ± 3.5 0.7 ± 1.7 0.3 ± 1.0	3.4 ± 4.0 2.0 ± 2.8 0.1 ± 2.0 0.3 ± 1.6	0.836 0.344 0.154 0.817
- DMFT - DT - MT - FT	0.6 ± 1.3 0.4 ± 1.0 0.01 ± 0.11 0.17 ± 0.8	0.6 ± 1.3 0.3 ± 0.7 0.07 ± 0.47 0.21 ± 0.8	0.838 0.923 0.556 0.534
- No. of caries free children (%)	23(30.7%)	20(26.7%)	0.718

In the cardiac group 30.7% (n=23) children were caries free as compared to 26.7% (n=20) children in the control group. But the difference is not significant ($p<0.05$)

The mean decayed components and mean dmft/ DMFT were slightly higher in the cardiac group as compared to the control, in both the primary and permanent dentitions.

In the control group the mean dmft were slightly higher as compared to cardiac group, in both the primary and permanent dentitions.

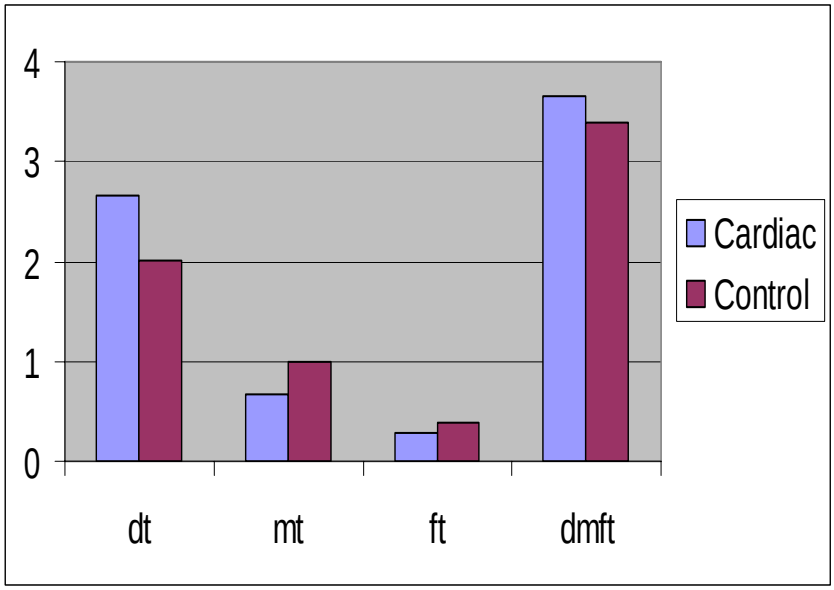

Figure 5.2- dt, mt, ft and dmft for the cardiac and control groups for the total sample.

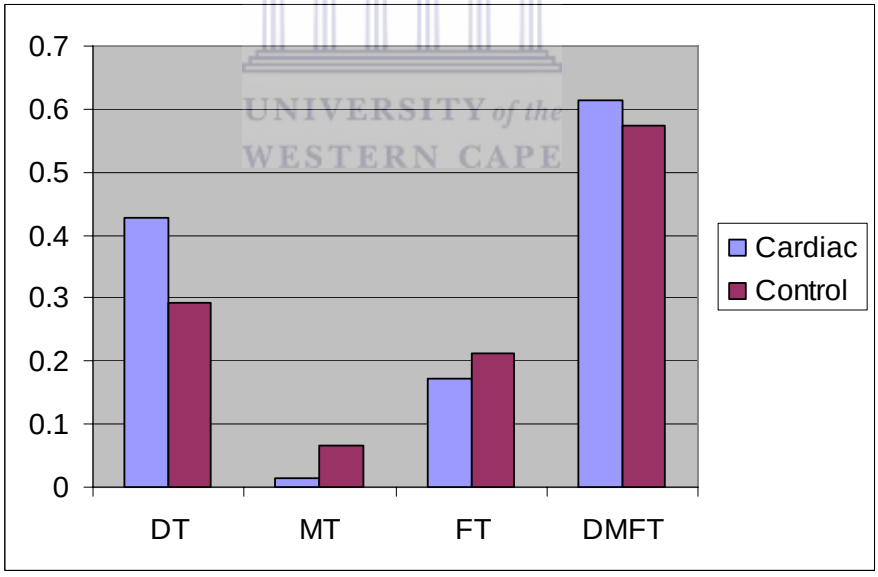

Figure 5.3- DT, MT, FT and DMFT for the cardiac and control groups for the total sample

The values of dmft, dt, mt, ft, DMFT, DT, MT and FT in the cardiac and control subgroups (1-6 years and 7-12 years)is shown in the Table 5.4, which is given below.

Table 5.4 - dmft, DMFT in the cardiac and control groups age subgroups.

Age Groups (years)	CCD Group	Control group	P value
1-6			
Total children in a group	35	35	
Caries free children	17(75.8%)	15(67.4%)	
dmft	3.47 ± 5.08	3.74 ± 4.69	0.49
- dt	2.71 ± 4.38	2.74 ± 3.44	0.41
- mt	0.47 ± 1.58	0.63 ± 1.59	0.53
- ft	0.29 ± 1.00	0.37 ± 2.19	0.31
DMFT	0.06 ± 0.34	0	0.31
- DT	0.06 ± 0.34	0	0.31
- MT	0	0	1.0
- FT	0	0	1.0
7-12			
Total children in a group	40	40	
Caries free children	6(28.3%)	5(23.8%)	
dmft	3.23 ± 3.72	3.08 ± 3.46	0.28
- dt	2.02 ± 2.73	1.38 ± 1.91	0.32
- mt	1.07 ± 2.33	1.30 ± 2.39	0.25
- ft	0.13 ± 0.99	0.40 ± 0.98	0.18
DMFT	0.93 ± 1.58	1.08 ± 1.59	0.53
- DT	0.63 ± 1.33	0.55 ± 0.98	0.61
- MT	0.06 ± 0.20	0.13 ± 0.64	0.15
- FT	0.29 ± 1.05	0.40 ± 1.05	0.32

There were no statistically significant differences in the dmft, DMFT indexes between cardiac and control groups in any of the age subgroups. However the dmft in 6-12 years age subgroup is slightly higher than the 7-12 years age subgroup in both the cardiac and the control groups.

5.5- Developmental dental anomalies:

Table 5.5 shows, in the overall cardiac group there were eight (10.7%) patients with at least one developmental enamel defect of the primary teeth as compared with only three patients (4%) in the control group (p=0.27). In contrast, in the permanent dentition cardiac group had four cases (5.3%) as compared to three (4%) patients in the control group. These results were not statistically significant.

Table 5.5- Developmental defects in the cardiac and control groups

Developmental enamel defect	Number of Patients Cardiac=75	Number of Patients Control=75	P value
Primary Permanent	8 (10.7%) 4 (5.3%)	3 (4%) 3 (4%)	0.27

5.6- Plaque and Gingivitis:

Although there was a higher mean plaque score in the CCD group compared with the controls (mean value= 54.7% vs. 45.3%, p = 0.33), the difference was not statistically significant. The gingival inflammation was significantly higher in the cardiac group (22.7% vs. 9.3%, p= 0.04) as compared to the control group, as shown in Table 5.6. None of the patients presented with cyanosed gums or even cyanosis anywhere in the oral cavity.

Table 5.6- Plaque and gingivitis in cardiac and controls

Group	Number of Patients Cardiac=75	Number of Patients Control=75	P value
Plaque			
Present	41(54.7%)	34(45.3%)	P=0.32
Absent	34(45.3%)	41(54.7%)	
Gingivitis			
Healthy	58(77.3%)	68(90.7%)	P = 0.04
Inflamed	17(22.7%)	7(9.3%)	
Cyanosed			

5.7- Chronic medication intake:

Many patients with congenital heart disease received sweetened medication several times daily, including digoxin syrup containing 30% sucrose, and chlorthiazide and spironolactone containing approximately 20% sucrose. It was therefore of interest to compare the numbers of caries free children in the groups of children with CCD with and without medication intake, to determine if chronic sweetened medication is associated with increased caries risk . As shown in Table 5.7, in CCD group 18 (28%) patients were caries free as compared to only 5(42%) in the group who were on chronic medication intake. There was no statistically significant relationship between the decay experience in the children who are on chronic medication and those who were not on medication.

Table 5.7- Cardiac medication and its relationship with caries in the cardiac group.

Medication	Number of Cardiac patients	Number of caries free children
No medication intake	64(85%)	18(28%)
Chronic medication intake	11(14%)	5(42%)

5.8- Preventive Dental Health Behavior:

In response to the question on oral hygiene we found no difference between the cardiac and control groups. In the cardiac group 61% of the children were brushing their own teeth while in control 65% were brushing their own teeth. Twenty eight percent of the cardiac group children had parental assistance as compared to 24% in the control group.

Forty six percent of the children in the cardiac group reported that they brushed twice a day as compared to thirty seven percent in the control group, while 50% in the cardiac group brush only once a day as compared to 53% in the control group.

Table 5.8 -Shows the parental response of the questions related with oral hygiene of the child in two groups.

Questions and answer options	**Cardiac Group**	**Control group**
Who brushes the childs teeth?		
None	3 (4%)	5(6.7%)
Child	46 (61.3%)	49(65.3%)
Caregiver	21(28 %)	18(24%)
Both	5(6.7%)	3(4%)
Tooth brushing frequency		
Never	2(2.7%)	6(8%)
1/ day	38(50.7%)	40(53.3%)
2 /day	35(46.7%)	28(37.3%)
More	0	1(1.3%)
Where did you get information on how to look after your child's teeth?		
Self	46(61.3%)	56(74.7%)
Dentist	14(18.7%)	8(10.7%)
Oral hygienist	3(4%)	0
Television	3(4%)	3(4%)
School	7(9.3%)	7(9.3%)
Others	2(2.7%)	1(1.3%)

In the cardiac group, 38% of the parents defined dental plaque as bacteria compared with 18% in the control group. The parental awareness regarding plaque was higher in the cardiac group as compared to the controls.

Table 5.9- parental awareness about dental plaque

Question and answer options	**Cardiac Group**	**Control group**
What is dental plaque?		
Don't know	11(14.7%)	26(34.7%)
White /yellow deposit	29(38.7%)	28(37.3%)
Stains	1(1.3%)	6(8%)
Bacteria	29(38.7%)	14(18.7%)
Food/debris	5(6.7%)	1(1.3%)
Any other	0	0

5.8.1- Fluoride awareness:

The 53% of the parents of the cardiac group were aware of the actions of fluoride for teeth. In the controls, 63% of the parents were aware of the fluoride but only 64% were using any form of fluoride, as compared to 79% in the cardiac group.

Table 5.10- Parental awareness of fluoride action

Question and answer options	Cardiac Group	Control group
Do you know what fluoride does for teeth?		
No	35(47%)	28 (37.3%)
Yes	40(53.3%)	47(63%)
Have you used fluoride in any of the following forms?		
None	15(20%)	26(35%)
Toothpaste	59(79%)	48(64%)
Tablets	1(1.3%)	0
Gel	0	0
Any other	0	1(1.3%)

5.8.2- Dental treatment provided by professionals

The parental compliance about the dental needs of children in both groups was poor. Almost 80% of the patients in both groups had never seen a dentist in the last six months. The patients in the cardiac group (9%) received the preventive treatment greater than the control group (4%), but it was not statistically significant.

Table 5.11- Previous dental treatment provided

Question and answer options	**Cardiac Group**	**Control group**
What dental treatment has your child received in the last 6 months?		
Preventive treatment	6(9%)	3(4%)
Restorative treatment	2(2.7%)	4(5.3%)
Extractions	5(6.7%)	7(9.3%)
None	61 (81.3%)	60(80%)

5.8.3- Infective endocarditis:

In response to the cardiac specific questions, only 15% parents of the control group replied 'yes' to the question that the mouth condition can affect the heart, as compared to almost 45% in the control group. In the cardiac group parental knowledge about the term infective endocarditis was limited (12%).

Table 5.12- Parental knowledge about infective endocarditis

Question and answer options	**CCD Group**	**Control group**
Do you think that the condition of your child's mouth condition can affect his/her heart?		
No	41(54.7%)	60(80%)
Yes	34(45.3%)	15(20%)
Do you know what infective endocarditis is?		
No	64(85.3%)	71(95%)
Yes	11(15%)	4(5%)

5.8.4. Pre-operative Prophylaxis:

Table 5.13 shows details of the response to the pre-operative prophylaxis. Forty four (58.7%) patients in the cardiac group had never visited the dentist to date. Twenty-one (28%) cardiac patients had no information about the pre-operative prophylaxis in their folders, rest of them doesn't remember whether the child was provided with pre-operative prophylaxis or not. Ten (13.3%) were prescribed Amoxicillin for the dental treatment. None of the patients reported about the clindamycin or any other antibiotic prophylaxis.

Table 5.13- Antibiotic prophylaxis before dental treatment in cardiac patients

Was the child given medicine before dental treatment?	
No	44(58.7%)
Yes	21(28%)

5.9. Educational level of parents:

When the parental educational level was compared with the caries experience and oral hygiene awareness in the cardiac and control groups, no significant difference were established.

Table 5.14- Parental education level

Educational level	**CCD Group**	**Control group**
Primary	29(39%)	31(41.3%)
Secondary	42(56%)	40(53.3%)
Tertiary	4(5.3%)	4(5.3%)

CHAPTER 6

DISCUSSION

In spite of the significance of heart disease in dental management, little previous research has been conducted on the oral health of the affected individuals. There are few prevalence studies on the oral and dental status of children with cardiac diseases in the African region (Marijon et al, 2006; Longo-Mbenza et al., 1998; Amoah and Kallen, 2000) and none in the Western Cape, South Africa.

6.1- Dental caries:

The present study showed no significant differences between the caries scores for children with heart disease and the healthy controls. This result is similar to the findings of the two previous studies done in UK by Pollard MA and Curzon MEJ (1992) and the study by Franco et al (1996). Another study done in Australia by Hallet et al (1992) also supports our results.

There were forty males and thirty five females in each group but no correlation was found between the caries experience, developmental enamel defects, plaque deposits or gingivitis and gender.

The result of this study showed that cardiac group compared to control group generally had a higher decay component (dt =2.67 vs. 2.0 and DT = 0.43 vs. 0.29) and a lower missing component (mt= 0.68 vs. 0.99 MT= 0.01vs 0.07), but this was not statistically significant.

The result of the study was similar with the South African Oral Health Survey by van Wyk and van Wyk (2004). In South Africa the decay component is usually higher in the whole population. Extraction was the only treatment provided. The survey showed that only 39.7% of the 6-year old children were caries free which was below the goal of 50% set by the Department of Health (DoH) for the year 2000. The DMFT of 1.1 for the 12 year old group was below 1.5 set by the DoH for this group for the year 2000. Based on the Unmet Treatment Need Index more than 80% of caries in children is not treated. They found out that there the greatest need for the treatment of dental caries in South African children was for preventive services, restorations and fillings. The results of our study also showed a high decay component in the cardiac and control groups. In case of cardiac group, 73.3% had carious lesions while in control group 69.9% had carious lesions.

The high prevalence of dental health problems in cardiac children are a special cause for concern as there are several reasons why healthy teeth are of benefit for these children. The overall increased vulnerability of cardiac child to stressful treatment procedures is one major reason to focus on caries prevention. If dental treatment is necessary painful and stressful situations should be avoided. Local anesthesia should be used and sedation should be considered. In some vulnerable children, treatment using sedation should be performed in cooperation with the child's cardiologist.

Poor dental health also gives an increased risk of bacteraemia that may lead to infective endocarditis. Healthy teeth may decrease this risk. Dentists are therefore advised to provide antibiotic prophylaxis before invasive dental procedures and healthy teeth among cardiac children may therefore contribute to the decrease in the use of antibiotics, which are commonly needed for other infections.

An additional factor supporting the benefits of dental health is increased risk of general anesthesia and a risk of prolonged bleeding among children taking Warfarin. Of major significance is the fact that untreated caries can be contraindicated for heart surgery (Hayers et al, 2001). As patients with more complex anomalies often require several surgical interventions, it is particularly important that scheduled surgery does not have to be postponed because of dental disease.

The untreated dental decay in the patients with heart disease has a significant implication in the medical care of these patients. Untreated dental decay may develop quickly into pulp infections which are associated with bacteraemia, endocarditis, and even brain abscesses (Munroe CO and Lazarus TL, 1976; Cawson RA, 1981; Bayliss et al, 1983; Lampe, 1978).

6.2- Developmental enamel defects:

Although there were no significant differences in the developmental enamel defects in the two groups about 10.3% of the cardiac group presented with such defects in the primary dentition. In the control group only 4% presented with defects. In the permanent dentition these differences were much less pronounced.

According to Scully and Cawson (2005) patients with congenital heart diseases have a high frequency of enamel defects. Radford (1989, 1990) and Jensen (1983) have shown the patients with congenital heart defects have increased prevalence of developmental defects. It is most likely to be related to the environmental and hereditary factors associated with the etiology of congenital heart defects. It is also possible that enamel hypoplasia in cardiac children has resulted from systemic disturbances, such as cardiac failure and surgical

complications associated with the cardiac disease during prenatal and neonatal development.

A study by Hallet et al (1992) in Australia reported almost 52% of the primary teeth of patients with congenital heart disease had at least one developmental defect as compared to only 21% in controls ($p<0.01$). However, a study by Franco et al (1996) in UK did not find any significant difference between the cardiac and control groups. They also found that if the white opacities were more in the control group than the cardiac group.

6.3- Plaque and gingivitis:

Scully and Cawson (2005) proposed that heart patients suffer from high plaque score and periodontal disease. Franco et al (1996) in their case control study on sixty children in each group did not find any significant difference in the number of sites covered with plaque. However, in both groups there was a significant difference between the primary and permanent teeth, with primary teeth having twice as many surfaces covered with plaque. (p= o.oo22). They also found similar levels of gingival inflammation related to both primary and permanent teeth. The gingivae related to the primary teeth were significantly less inflamed than those related to permanent teeth. (p= 0.021). They found that primary teeth had less than 6% of plaque-covered surfaces with gingival inflammation whereas permanent teeth had 38% (p=0.001).

Pollard et al (1992) also carried out a case-control study with 100 study and 100 control patients ranging from 2- 16 years. They subdivided the children into three sub-groups 2-4 years, 5-9 years and 10 -16 years. Comparing the study and control patients in each subgroup, there were no significant differences in gingivitis, plaque

or calculus. Hallet (1992) also did not find any significant difference between the two groups for the plaque and gingivitis scores. Their results showed higher mean plaque score in the CCD group compared with control (0.65 ± 0.22 vs. 0.58 ± 0.21, p>0.1).

In this study, the cardiac patients generally had higher levels of plaque when compared with the controls (54.7% vs. 45.3%, p=0.33). But this difference was not statistically significant. The cardiac group had significantly higher levels of gingivitis as compared to control (22.7% vs. 9.3%).

Children with congenital heart defects have more severe gingival inflammatory conditions than normal population. Specific reasons for this are not clear but include a low priority of dental care held by primary attendants of chronically ill children. They also harbored specific HACEK microbes (Haemophilus spp, Actinobacillus actinomycetemcomitans spp, Cardiobacterium hominis, Eikenella corrodens and Kingella spp) especially, Eikenella corrodens (E.c.) and Actinobacillus actinomycetemcomitans (A.a.) within the gingival crevice to a greater extent than their normal counterparts (Steelman et al,2000 and 2003).

6.4- Infective endocarditis

As discussed previously, children with acquired or congenital endocardial defects may develop infective endocarditis (IE) following bacteraemia of dental origin. The consequences of dental disease and certain dental procedures are potentially so serious that these children require priority dental treatment. A continuing comprehensive preventive care regimen is needed from as early age as is possible and if restorative treatment is required it should be of highest priority (British Dental Association, 1977).

The results of this study showed that only 13% percent of the parents were fully aware of need and consequences of antibiotic prophylaxis. Thirty three percent of the parents of the cardiac group replied that they do not know if the prophylaxis was given or not. Twenty nine percent were totally unaware of the antibiotic prophylaxis need for their children. The cardiology clinic in the Tygerberg hospital provides them with a full range of information about infective endocarditis, antibiotic prophylaxis and preventive regimen, as soon as they are diagnosed. Even after that when the question about antibiotic prophylaxis was asked most of them were unaware and only few of them had previous dental visits. The reason for this could be the providing these patients and their caregivers with too much information and the lack of reinforcement. The child's cardiac disease is such an overwhelming priority for the parent, the paediatric cardiologist, and the primary healthcare provider, that other equally important healthcare needs may be neglected or ignored.

The results of this study correlates with the study by Chatterjee et al in (2004) in which they also evaluated the awareness of infective endocarditis prophylaxis in cardiac patients after contact with the physician. The study involved two groups of the patients (1) Referred patients with an established cardiac diagnosis; (2) Patients diagnosed and dental followed up. All the patients in the outpatient clinic received supervised infective endocarditis prevention education routinely. Evaluation was done by a questionnaire. In the first group, only 11% of the parents were aware and the rest 89% were unaware. In the second group 59% were aware and 49% were not aware.

In this study, one of the patients was found to have atrial ventricular septal defect along with infective endocarditis. But unfortunately, the

patient was in foster care and just moved from Johannesburg to Cape Town, so none of the details about how the patient acquired the condition become available. The patient had a poor oral hygiene and had few extractions that he said he had it 2 years earlier. The American Heart Association (1990) and Working party of the British Society for Antimicrobial Chemotherapy (1992) suggested that the oral health of these special risk patients be monitored regularly and maintained to the highest levels possible. The patients who had one episode of infective endocarditis are especially susceptible to developing this condition again.

Despite of the efforts of the physician and the dentist, there is a high level of unawareness among the parents about infective endocarditis. The reason for this could be the cost of dental treatment, fear of dental environment or equipment, family problems, lack of knowledge or understanding of the need, and distrust of the dentist. The demanding situation for the parents and family should be acknowledged and understood.

The parents' awareness of infective endocarditis prophylaxis is at an extremely low level in the study population inspite of contact with the physicians. The physicians have to reinforce infective endocarditis and dental hygiene education at every contact with parents and patients of the target population to prevent infective endocarditis. Dental screening of all the paediatric cardiology patients at the paediatric outpatient clinic or at the dental clinic can help improve awareness.

6.5- Oral hygiene practise and awareness

Oral hygiene and dental prophylaxis in patients at risk from infective endocarditis is sometimes erroneously interpreted as solely meaning antibiotic prophylaxis. Prophylaxis against infective endocarditis should primarily be concerned with maintenance of good oral hygiene and prevention of oral disease to reduce the frequency and magnitude of spontaneous bacteraemias. This is probably far more important than antibiotic prophylaxis in reducing the incidence of streptococcal endocarditis (Guntheroth, 1984; Shanson, 1987).

The results of the study showed a low level of oral hygiene awareness and practise among parents and children in the study group as well as the control group. The mothers' or caregivers' education level is very important for that but in our study we did not find any significant relationship between the education level or oral hygiene awareness and practise. The reason for this could be that most of the mothers are working and the children mostly stay with their grandparents or at daycare.

The reason most often cited for the lack of dental care by the parents of children with heart disease was lack of recognition of their child's need for dental services. This suggests inadequate parental education regarding the preventive health care needs of children with heart disease. Parents are frequently counseled regarding their child's need for antibiotic prophylaxis for the prevention of infective endocarditis during dental procedures, but information concerning the importance of dental disease prevention may be omitted.

The child's cardiac disease is such an overwhelming priority for the parent, the paediatric cardiologist, and the primary health care providers, that other equally important health care needs may be neglected or ignored. Kanthor et al suggested, to provide complete

and effective health care to children with complex or/and chronic disabilities, physicians and parents must clearly understand as early as possible who is responsible for each aspect of childcare.

Adequate dental care may be neglected in children with heart disease and that insufficient education and emphasis on preventive health care may be the primary reason for these deficiencies. Increased educational efforts directed at parents and their children with heart disease, regarding primary preventive health care needs of children with heart disease may remedy the insufficient care.

CHAPTER 7

LIMITATIONS OF THE STUDY

- The Western Cape already has got a high level of dental decay as shown in the study by van Wyk and van Wyk (2004); this could be the reason for insignificant differences in the decay experience between the study and control groups. The possible reflection of the differences in the decay experience between the two groups could have been established in the large sample.

CHAPTER 8

CONCLUSION

- There was no significant difference in the caries experience between the two groups. The cardiac group had a higher decay component and a lower missing component which may be an indication of the lack of dental intervention.

- The gingival inflammation was significantly higher in the cardiac group, although the plaque scores were similar in the two groups. These high levels of gingival inflammation in the cardiac group put the patient's life at risk of infective endocarditis.

- The cardiac group had a higher decay, but lower missing and filled components. This may be a reflection of the unmet dental treatment needs of the cardiac patient. There is a need of intensive dental care for these children.

- The parents of the both groups were mostly unaware of oral hygiene practises and very few of these children had visited the dentist or received dental treatment.

- In the cardiac group, the awareness about infective endocarditis was extremely low, despite all the efforts by the physicians.

- There is a gap between information imparted by the experts and the levels of understanding of this knowledge. This should be addressed.

CHAPTER 9

RECOMMENDATIONS

- Cardiac patients, whose general health is at risk because of the poor dental health, should be given priority dental treatment.

- Children with severe heart disease should be referred to a paediatric dentist before they are one year old.

- An individual treatment plan to maintain oral health, based on risk assessment, should be established for all children with cardiac disease.

- There should be closer co-operation between paediatric cardiologists and paediatric dentists to help improve dental care for these children.

- Written communication by paediatric cardiologist to dental surgeon clearly supporting the need for good dental care.

- If feasible, screening by a dental hygienist of all children attending the paediatric cardiologist clinics starting from the age of one year.

- Increasing participation of the nursing personnel in the education of families regarding oral health needs.

- Availability and distribution of health education literature to parents promoting the child's need for preventive health care.

- Children with evidence of dental disease should be promptly referred to a dental clinic.

- The focus should be on caries prevention and include dietary counseling, oral hygiene and fluoride supplements if necessary, and to maintain excellent oral health.

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APPENDIX 1

DATA CAPTURE SHEET

1. GENERAL INFORMATION

Name: …….. Regt. No: ……..

Age (yrs): ☐☐ Gender (Male = 1, Female = 2) ☐

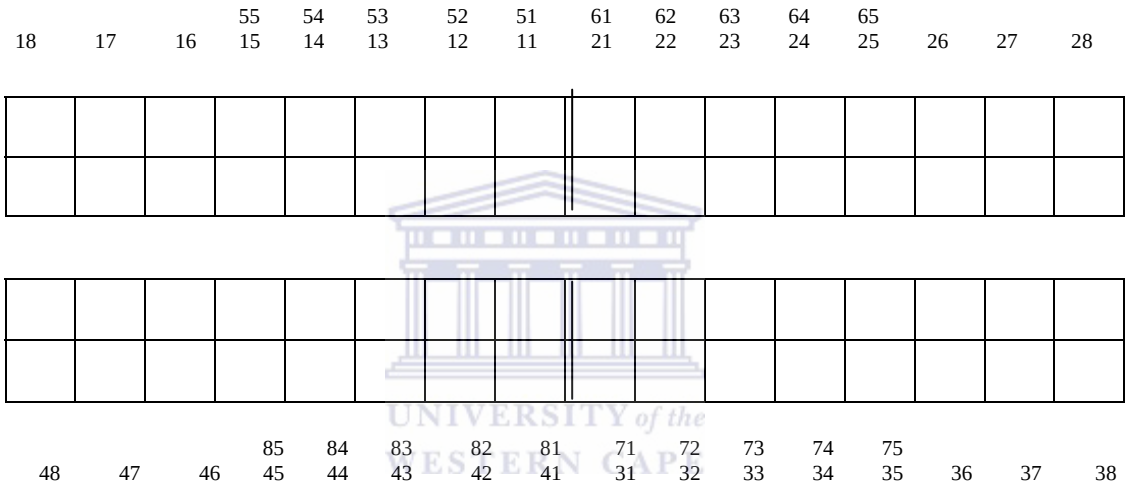
2. MEDICAL STATUS

Medical diagnosis …….

Medication …….....

Type of cardiac disease (Congenital = 1, Acquired = 2) ☐

3. ORAL HEALTH STATUS



4. DEVELOPMENTAL DEFECTS OF ENAMEL

Type of defect	Code	
	Permanent teeth	Primary teeth
Normal	0	A
Opacity (white/cream)	1	B
Opacity (yellow/brown)	2	C
Hypoplasia (pits)	3	D
Hypoplasia (grooves: horizontal)	4	E
Hypoplasia (missing enamel)	5	F
Discoloured enamel (not associated with opacity)	6	G
Other defects	7	H
Combination of defects	8	J

5-Caries Status

Permanent teeth	Primary teeth
0 = sound	A
1 = decayed	B
2 = filled & decayed	C
3 = filled, no decay	D
4 = missing due caries	E
5 = missing any other reason	-
6 = sealant, varnish	F
7 = bridge abutment or crown	G
8 = unerupted tooth	-
9 = excluded tooth	-

6. Gingival condition

Healthy = 1

Inflamed = 2

Cyanosed = 3

☐

7. Plaque Index

Present =1

Absent = 2

☐

8-Type of Antibiotic prophylaxis

None = 0

Amoxicillin = 1

Clindamycin = 2

Any other = 3

N/A = 4

☐

APPENDIX 2

Questionnaire

A- Personal information:

Child's name _____ Date of examination_____
Date of birth _____ Registration No._____
Age (yrs) _____ Sibling position _____

B- Education level
Mother / Father / Caregiver _____ Primary / Secondary / Tertiary

C- Oral Hygiene Awareness:

1- Who brushes the child's teeth?

Child	1
Caregiver	2
Both	3
None	4
Others	5

2- When does the child brush his/her teeth?

Once a day	1
Twice a day	2
More	3
Never	4
Others	5

3- Where did you get information on how to look after your child's teeth?

Dentist	1
Oral hygienist	2
Self	3
Television	4
School	5
Other	6

4- What is dental plaque?

Don't know	1
White /yellow deposit	2
Strains	3
Bacteria	4
Food/debris	5
Any other	6

5- Do you know what Fluoride does for teeth?

Yes	1
No	2

6- Have you used fluoride in any of the following forms?

Toothpaste	1
Tablets	2
Gel	3
None	4
Any other	5

7-What dental treatment has your child received in the last 6 months?

Oral hygiene instructions	1
Fluoride application	2
Fissure sealants	3
Scaling & polishing	4
Fillings	5
Extractions	6
Any other	7

8-Do you think that the condition of your child's mouth condition can affect his/her heart?

Yes	1
No	2

9- Do you know what bacterial endocarditis is?

Don't know	1
Know	2
Specify	3

10- Was the child given medicine before dental treatment?

Yes	1
No	2
Don't know	3

APPENDIX 3

CONSENT FORM

University of the Western Cape

Faculty of Dentistry & WHO Collaborating

Centre for Oral Health

Paediatric Dentistry

Patients Information Letter and Consent

The department of Paediatric dentistry UWC is doing a study on the oral and dental health status of paediatric cardiac patients. The purpose of this study is to assess the oral and dental health status of your child.
Your child (in this study) will be examined clinically (no radiographs will be taken for this study). Participation in this study is on a voluntary basis, free of fees (only for this consultation visit). Refusal to participate will in no way jeopardize your child's future dental treatment. You have the right to withdraw from the study at any time.
You will be informed of any dental treatment(s) required for your child. The confidentiality of the gathered information will be kept at all times.

Consent

I, (father, mother, guardian) _____, herewith grant permission for my child (name), _____, to participate in the study. I have been informed of the procedures to be performed. I understand that the study is voluntary and that I may withdraw my child at any time. This will not prejudice my child or me.

Signature_____

Date_____

Researcher Sobia Zafar

Supervisor Dr S Harnekar

APPENDIX 4

World health Organization (WHO) guidelines of basic Oral Health Survey (1987).

Sound tooth -0 (A)

A tooth is recorded as sound if it shows no evidence of treated or untreated clinical caries. The stages of caries that precede cavitation, as well as other conditions similar to the early stages of caries, are excluded because they cannot be reliably diagnosed. Thus, teeth with the following defects, in the absence of other positive criteria, were coded as sound:

1. White or chalky spots;

2. Discolored or rough spots;

3. Stained pits or fissures in the enamel that catch the explorer but do not have a detectably softened floor, undermined enamel, or softening of the walls;

4. Dark, shiny, hard, pitted areas of enamel in a tooth showing signs of moderate to severe fluorosis.

All questionable lesions were coded as sound.

Decayed tooth -1(B)

Caries was recorded as present when a lesion in a pit or fissure, or on a smooth tooth surface, had a detectably softened floor, undermined enamel or softened wall. A tooth with a temporary filling was also included in this category. A tooth that contains one or more permanent restorations and one or more areas that are decayed

(secondary caries) should also be included in this category. Where any doubt existed, caries was not recorded as present.

Filled tooth with decay- 2(C)

A tooth was scored as filled with decay when it contains one or more permanent restorations and one or more areas that are decayed. No distinction is made between the primary and secondary caries (i.e. whether or not the carious lesions are in physical association with the restoration(s).

Filled without decay- 3(D)

Teeth were considered filled without decay when one or more permanent restorations are present and there is no secondary (recurrent) caries or other area of the tooth with primary caries. A tooth with a crown placed because of previous decay was recorded in this category.

Tooth missing due to caries- 4(E)

This score was used for teeth that have been extracted because of caries. For missing primary teeth, this score was used only if the subject is at an age when normal exfoliation would not be a sufficient explanation for absence.

Permanent tooth missing for any other reason -5

This code was used for the permanent teeth judged to be absent congenitally, or extracted for orthodontic reasons or because of trauma, etc.

Sealant- 6(F)

This code was used for teeth in which fissure sealants has been placed on the occlusal surface, or for teeth in which occlusal fissure has been enlarged with rounded or flamed shaped bur and a composite material placed. If the tooth with a sealant has decay it should be coded as 1(decayed).

Special crown- 7(G)

This code was used for crowns placed for reason other than caries.

Unerupted tooth -8

This classification was restricted to permanent teeth and was used only for a tooth space with an unerupted permanent tooth but without a primary tooth.

Excluded tooth- 9

This code was used for any tooth that cannot be examined.

Appendix 5

Developmental Enamel defects:

Commission on Oral Health, Research and epidemiology. An epidemiological index of developmental defects of dental enamel, DDE Index, was used for recording enamel defects.

Developmental enamel defect is defined as disturbance in hard tissue matrices and in their mineralization arising during odontogenesis. Disturbances may be clinically obvious; they may be localized affecting single teeth or affect multiple teeth. The defect may affect all the teeth, primary only, or permanent only, and may also involve dentine or cementum or both.

Opacity

It is defined as a quanlitative defect of enamel identified visually as an abnormality in the translucency of enamel. It is characterized by a white or discolored (cream, brown, yellow) area but in all cases the enamel surface is smooth and the thickness of enamel is normal, except in some instances when associated with hypoplasia.
White/cream = B (primary teeth), 1(permanent teeth)
Yellow/brown= C (primary teeth), 2(permanent teeth)

Hypoplasia

It is defined as a quantitative defect of enamel visually and morphologically identified as involving the surface of the enamel (an external defect) and associated with a reduced thickness of enamel. The defective enamel may occur as (a) shallow or deep pits or rows

of pits arranged horizontally in a linear fashion across the tooth surface or generally distributed over the whole or part of enamel surface; (b) the defective enamel may occur as small or large wide or narrow grooves; (c) in some instances there may be partial or complete absence of enamel over small or considerable areas of dentine.

Pits = D (primary teeth), 3 (permanent teeth)
Grooves: horizontal = E (primary teeth), 4(permanent teeth)
Grooves: Vertical = F (primary teeth), 5 (permanent teeth)
Missing enamel = G (primary teeth), 6(permanent teeth)

Discolored enamel

It is defined as an obvious abnormal appearance of enamel which because of its color and distribution can not be considered within the normal range of variation in color and shade of tooth enamel. This category excludes colored opacities.
H (primary teeth), 7 (permanent teeth)

Combination of hypoplasia and opacities

The combination of can occur on the same tooth surface. They may be quite distinct from each other, that is, separated by normal enamel or as a composite lesion composed on an adjacent opacity and hypoplasia.
I (primary teeth), 8 (permanent teeth)

APPENDIX 6

Calibration Form

1. GENERAL INFORMATION

Name: …….. Regt. No: ……..

Age (yrs): ☐☐

2. Examiner

SYH 1 ☐

SZ 2

3. CARIES HEALTH STATUS

			55	54	53	52	51	61	62	63	64	65			
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
			85	84	83	82	81	71	72	73	74	75			

WHO Caries Status Coding System

Permanent teeth	Primary teeth
0 = sound	A
1 = decayed	B
2 = filled & decayed	C
3 = filled, no decay	D
4 = missing due caries	E
5 = missing any other reason	-
6 = sealant, varnish	F
7 = bridge abutment or crown	G
8 = unerupted tooth	-
9 = excluded tooth	-

4. Gingival condition

Healthy = 1

Inflamed = 2

Cyanosed = 3 ☐

5. Plaque Index

Present =1

Absent = 2 ☐

Appendix 7

PRECAUTIONS FOR DENTAL TREATMENT

The following precaution should be taken while treating a patient with a heart disease:

- Always give prophylaxis in susceptible patients.
- An aspirating syringe should be used to give a local anaesthetic, since epinephrine in the anaesthesia entering the vessel may theoretically raise the blood pressure or precipitate dysrhythmias.
- Adequate analgesia must be provided.
- Gingival retraction cords containing epinephrine should be avoided.
- Conscious sedation preferably with nitrous oxide can be given with the approval of the physician.
- Pulpotomies and pulpectomies should be avoided in these patients.
- General anesthesia should generally be avoided and is matter for expert anaesthetists in hospital