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A Study of participation in sports by children with a below elbow limb deficiency

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A STUDY OF PARTICIPATION IN SPORTS BY CHILDREN WITH A BELOW ELBOW LIMB DEFICIENCY

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By

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ABSTRACT

A STUDY OF PARTICIPATION IN SPORTS BY CHILDREN WITH A BELOW ELBOW LIMB DEFICIENCY

by Kristin Syms

The objectives of this study were to gather data about participation in organized sports by children with a below elbow limb deficiency, rate of injuries sustained as a result of this participation, and prosthetic use and wearing patterns. Questionnaires were sent to parents of children with a limb deficiency aged 7 to 18 years. Eighty-six questionnaires were returned with valid data. Data were analyzed descriptively. The data indicate that the majority of the children with a below elbow limb deficiency in this study participated in sports. The risk of injury to this population appeared to be no higher than for able-bodied children. A small number of able-bodied children were injured by those wearing a prosthesis. A small number of children who wore a prosthesis during sports had damaged their prosthesis. The majority of the children in this study wore their prosthesis daily, and a smaller number during sports.

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CHAPTER 1

INTRODUCTION

Purpose

The purposes of this study were fourfold: 1) to determine the frequency with which children aged seven to eighteen who have a below elbow limb deficiency participate in sports; 2) to identify the sports in which these children more commonly engage; 3) to determine the rate of injuries that occur to this population when participating in organized sports, and 4) to identify whether injuries to able-bodied children have been attributed to children wearing a below elbow limb prosthesis when playing sports.

Statement of the Problem

Children with a below elbow limb deficiency may have decreased opportunities to participate in sports at the same level as their able-bodied peers. The nature of their disability, however, does not require that they participate in adaptive physical education or organized sports. Although they can adequately participate in a range of team sports (LeVeau, 1984), many children with a below elbow limb deficiency at times can be denied the opportunity to participate. It may be a perception of sports officials that these children are at higher risk for injuring themselves or others when wearing a prosthesis during play. If children with a below elbow limb deficiency participate in team sports without a prosthetic device, they may be at a disadvantage due to decreased bimanual skills, limited reach, diminished ball handling skills, and predisposing postural imbalance. Wearing a prosthesis during play has benefits which include improved proprioception in a limb, in addition to developed proficiency

in the use of a specific prosthetic device (Valliant, Bezzubyk, Daley, & Ash, 1985). Disadvantages of prosthetic wear in sports may include decreased sensation and proprioception, decreased skilled movements due to the weight or construction of the prosthesis, or chance of injury to self or others secondary to the materials in the prosthesis. The choice of whether or not the child should wear a prosthesis during play in sports should be left up to the child, based on his or her preference and ability, and careful analysis of the risks to the child or fellow athletes.

The 1990-91 National Federal State High School Association rule books for varied contact sports either do not allow hard materials such as plastics or metal as those found in a prosthesis to be worn, or they offer information regarding eligibility and safety issues that can be interpreted as conflicting. As a result, the opportunity for a child with a below elbow limb deficiency to engage in a contact sport with or without a prosthesis is left to the discretion of sports officials and their interpretation of the sport's safety rules

and guidelines. Currently, information is not readily available to schools, health professionals, or families regarding state regulations and how to obtain authorization for the wearing of a prosthesis.

In reviewing the literature, no data regarding injury to children with a below elbow limb deficiency as a result of participation in sports were found, and limited information was found regarding the availability of suitable prosthetic types or wearing patterns specifically for sports.

Occupational therapists are often the health professionals who educate the child with a limb deficiency and their parents about sports and recreational aids and techniques. Therapists need to understand the risks and benefits of such activities as well as preferred prosthetic choice and wearing patterns. For a child to gain the obvious benefits that participation in sports can offer, it is imperative that sports officials, health professionals, and parents are provided with easily accessible and pertinent data regarding all issues and regulations. A need existed for factual baseline information

regarding sports participation by this population, prosthetic wearing patterns, and information about injuries that have occurred.

Objectives

The objectives for this study were as follows:

1. To identify the sports in which children with a below elbow limb deficiency aged 7 to 18 more commonly participate.
2. To determine the frequency with which children with a below elbow limb deficiency participate in sports.
3. To determine the frequency, type, and location of injuries that occur to children with a below elbow limb deficiency as a result of participation in organized sports.
4. To identify any similarities between the frequency, type, and location of injuries that occur to children with a below elbow limb deficiency, and the able-bodied population, as a result of participation in sports.

5. To determine the frequency, type, and location of injuries to same aged able-bodied children that can be attributed to children wearing a below elbow limb prosthesis during participation in sports.

6. To determine the types of below elbow prostheses and terminal devices owned, and the frequency of padding of prostheses when engaged in sports activities.

7. To determine the wearing patterns of prostheses by children with a below elbow limb deficiency, both on a daily basis, and when engaged in sports activities.

8. To determine the frequency with which a child with a below elbow limb deficiency damaged a prosthesis as a result of participation in organized sports.

9. To generate data which can be used to further study the implications that participation in sports activity has for a child with a below elbow limb deficiency.

Questions

This study was designed to answer the following questions:

1. In what sports do children with a below elbow limb deficiency aged 7 to 18 years participate more frequently?
2. What is the frequency with which children who have a below elbow limb deficiency participate in sports?
3. What are the frequency, type, and location of injuries that occur to children who have a below elbow limb deficiency as a result of participation in organized sports?
4. Are there any similarities between the frequency, type, and location of injuries that occur to children with a below elbow limb deficiency, and the able-bodied population, as a result of participation in sports?
5. What are the frequency, type, and location of injuries that occur to same aged able-bodied children which have been or can be attributed to children wearing a below elbow prosthetic device during participation in organized sports?

6. What are the types of below elbow limb prostheses and terminal devices owned, and what is the frequency of padding of prostheses when engaged in sports activities?
7. What are the wearing patterns of prostheses by children with a below elbow limb deficiency, both on a daily basis and when engaged in sports activities?
8. What is the frequency with which a child with a below elbow limb deficiency has damaged a prosthesis due to participation in organized sports?

Definitions

Definitions of terms used in this study are:

Able-bodied child: A child who has no physical disabilities that restrict him/her from any motor activity.

Amputation: Limb loss resulting from disease, injury, or congenital causes (Pedretti and Zolton, 1990).

Below elbow limb deficiency: An amputation of the upper extremity that is below the elbow. Can be classified as a short below elbow amputation or a long below elbow

amputation. The short below elbow amputation results in loss of hand and wrist function, forearm pronation and supination, and limited force in elbow flexion. The long below elbow amputation results in loss of hand and wrist function and most of forearm pronation and supination (Pedretti and Zolton, 1990).

Below elbow prosthesis: An active or passive device that allows increased function through varied prehension patterns or sport specific assistance depending on the terminal device used.

Contact Sport: Any sport that includes body to body contact as part of it's normal activity.

Injury: A physical occurrence from an external force that alters the ability of the participant to play, compete, or practice in the usual manner.

Organized sport: A sports activity that is officiated and adheres to national sports guidelines and regulations; may be a community based or an organized scholastic activity.

Participation: As it relates to sports, to be involved in an

organized non-contact or contact sport, for competitive or enjoyment purposes, while adhering to the sport's rules and regulations.

Padding: Any substance i.e., foam, rubber, cotton, etc. that is wrapped around the prosthesis to absorb the shock of contact with the intent of protecting sports participants from injury.

Terminal device: The component of the prosthesis that allows grasp and release through voluntary opening or voluntary closing type tension. Examples of terminal devices include the hook, cosmetic hand, Child Amputee Prosthetic Project (CAPP) terminal device, and sport specific devices which allow specific function and prehension.

Assumptions

The assumptions held by the researcher for this study were:

1. That the respondents will be either parents or guardians of children with a below elbow limb deficiency, and

2. That the participants would answer the questions honestly and accurately.

Limitations

There were several limitations in this study. The first was the sample size surveyed which was limited due to a low return rate from the respondents, secondary to compliance and out of date mailing lists. The information gathered is subject to lack of reliability based on interpretation of the questions in the survey form. Questions asked in the survey did not account for sensitivity of some issues in question. The definitions of injury and characteristics of the population are specific to this study, which limits comparison to other studies which may have different definitions or characteristics.

Significance of the Study

This study has generated data on the frequency with which children who have a below elbow limb deficiency participate in sports. In addition, it yields results as to the prevalence of injuries that occur to children with a below elbow limb deficiency and their able-bodied peers as a result of their participation in organized sports. Participation in sports and recreation activities offers a child benefits in both the psychological and physiological realms. Play and recreation are among the child's most prevalent forms of occupation. Denial of participation in sports based on identified disability or requirements to play in a way that inhibits one's most functional pattern may discourage a child from engaging in an activity. It becomes important to clarify the rules and regulations of particular sports for the benefit of the child with a below elbow limb deficiency, so that a child's discouragement is negated.

In reviewing the literature, no studies were found that

identify the participation rate of children with a below elbow limb deficiency in sports, or if these children are more apt to injure themselves or others through participation in sports. Many studies reported the incidence of injury in able-bodied children because of sports (Chandy and Grana, 1985; Goldberg, 1989; Kvist, et al., 1989). Recent literature suggested the need for research regarding participation in sports, particularly for athletes with disabilities, their access to sports, incidence of injury, prosthetic design choice, and clarification of safety rules and regulations (Depaw, 1986; DePaw, 1988; Melendez and LeBlanc, 1988; Micheli,1984; Stewart, 1983). This study was designed to begin to answer some of the questions related to these issues.

CHAPTER 2

LITERATURE REVIEW

Overview

The literature review provides background information on the following: prevalence of participation in sports by children with a disability, the benefits of participation in sports by children with a disability, prosthetic use, available prosthetic designs for use by children with a below elbow limb deficiency, and information on the current national regulations of wearing a prosthesis in varied sports. In addition, studies on injury statistics for able-bodied children will be presented and compared to the disabled population. The occupational behavior model provided the frame of reference for this study.

The Occupational Behavior Model

The occupational behavior model is based on the belief that "man through the use of his hands as they are energized by mind and will, can influence the state of his own health"

(Reilly cited in Reed, 1984, p. 98). Occupational behavior refers to the activities that occupy a person's time along a work-play continuum. It is felt that occupational behavior and achievement are developmentally acquired. Achievement can be facilitated and strengthened through play and work, and the drive for achievement creates interests, abilities, skills, habits of competition, and cooperation (Reilly cited in Reed, 1984).

Play is considered the antecedent preparation for work in this model. The activities in which one engages as a child has a direct effect on one's future activity patterns and role pursuits. Society is said to "program it's members for occupational behavior" (Reilly cited in Reed, 1984, p. 98) through engaging in activities of play, family living, school, and recreation. It seems evident that successful occupational behavior is reliant upon successful opportunities for participation in a variety of activities.

Participation in Sports by Those with a Disability

Activity patterns developed in early life are said to affect adult activities and provide an important means of socialization. Yoesting and Burkhead (1973) examined the activity levels of 137 able-bodied adults and compared it to their activity level as children. Data were gathered on their activity levels and preferences and number of outdoor recreational activities in which they participated as children and as adults. Findings indicated that the activity level of the individual as a child seemed to have a direct effect on the activity level of the individual as an adult, and that inactivity during childhood creates inactivity as adults. McClaskie, Napier, and Christensen (1986) reported similar findings based on a sample of 2,341 able-bodied adult respondents. Through completion of a questionnaire, it was found that the early life experiences of the respondents, and skills acquired during youth affect participation and skill in later life. Although both of these studies used able-bodied populations, the issues

of positive early life experience may be extrapolated to those with a disability.

Zoerink (1987) examined activity patterns of adult males with congenital and orthopedic disabilities and compared with able-bodied males. Fifty-three subjects had a congenital orthopedic disability, 60 had an acquired orthopedic disability, and 60 were able-bodied. Subjects were interviewed about their social and recreational opportunities during childhood and adolescence. Results showed that men with congenital disabilities recalled having had "more or about the same number of opportunities to play with friends, be involved in active games and in outdoor activities, and play at friends' homes" (Zoerink, 1987, p. 293). The three studies described above demonstrate the importance of participation in sports and recreation especially in one's early years, and the implications participation has later in life.

Only two studies were found that reported information on children with an amputation and their participation in recreational activities. Lambert and Sciora (1959) studied

prevalence of activity participation while wearing a prosthesis. Subjects were children ranging from preschool ages to 18 years. This study had several conclusions, but of most relevance to this study was the finding regarding activity participation. It was reported that of 121 respondents among whom the number of children with a below elbow limb deficiency was not specified, 100 were permitted to wear their prosthesis in all activities at school. The activities prohibited by some schools were swimming, football, gymnastics, and baseball. Swinging on a swing set was not permitted specifically for those with an upper extremity amputation. In addition, all activities, except sports, and all sports except football, basketball, and gymnastics were permitted if the child did not wear his prosthesis. Although old, this study demonstrated issues that may still be prevalent today.

Kegel, Webster, and Burgess (1980) surveyed persons with a lower extremity amputation about their participation in sports. Subjects were 450 men and women with lower

extremity amputations who had been discharged from a rehabilitation program at least three months prior to the study. One hundred subjects participated in the survey. The key conclusions based on the amputees' responses for this study were: 1) 60% of this population was active in sports, 2) younger persons who had acquired or congenital amputations were more active compared to subjects with vascular or tumor related amputations, and 3) the level of amputation did not seem to be a factor in participation rate. Reasons given by those who did not participate in sports included pain, embarrassment, insufficient training, and lack of organized sports programs for the disabled. Parental overprotectiveness, cost of a prosthesis, or fear of injury were not claimed to be factors for non-participation. The low response rate to this survey makes it difficult to generalize the results to all lower extremity amputees. However, these two studies suggest some pertinent and applicable issues that those with a below elbow limb deficiency may experience as well.

The Benefits of Sports Participation for Children with Disabilities

There are many physical advantages that participation in sports may have for children with disabilities. This portion of the literature review focuses on research concerning the psychological benefits of participation in sports. One psychological variable that is said to be positively affected by participation in sports is the child's self-esteem. Rubenfeld, Varni, Talbot, and Setoguchi (1988) conducted a study which assessed the psychological and social adjustment of 41 children aged 8 to 13 years who had limb deficiencies. Evaluative tools used included the Self-Perception Profile for Children, the Social Support Scale for Children, and the Family Environment Scale. Findings indicated that athletic competence was significantly related to self-esteem, as was social acceptance, scholastic acceptance, and behavioral conduct. In addition, perceived physical appearance was found to be a highly predictive factor of general self-esteem (r=.65,

$p<.001$). Although the sample size for this study was small, the findings were significant: the benefits of both athletics and prostheses that meet the needs of the child both physically and appearance wise may enable a child to possess better self-esteem.

One's body image can be influenced by engagement in physical exercise and activity. Simmel (1967) observed in amputee patients that their body image tended to be established in early life and is reliant upon the nature of the amputation; i.e., congenital vs. traumatic amputation. Body image is also said to be reliant on one's perception of their body and it's functioning capability, as well as the relationship of the body in space. (Silva and Klatsky, 1984). Valliant, Bezzubyk, Daley, and Asu (1985) found a positive relationship between activity and body image. A study was conducted of 161 physically disabled adults, of which 36 had an amputation. The type of amputation was not indicated. Of the 161 participants, 139 were actively involved in athletic competition. The participants were asked to complete the

Coopersmith Self-Esteem Inventory, Rotter's Locus of Control, and a social history questionnaire. Results indicated that the respondents who were athletically inclined reported higher self-esteem, were better educated, more satisfied with life, and were happier than those with a disability who did not participate in sports.

Prosthetic Use

With participation in sports by those with a disability, and more specifically an upper limb deficiency, comes the need for advanced design, support services, and subsequent research in order to understand the implications that prosthetics have for this population. Melendez and Leblanc (1988) addressed these issues in a study of prosthetic wearers. The subjects surveyed were 25 males aged 14.5 to 76, who were either prosthetic wearers or previous wearers of prostheses. Subjects were asked to describe their previous prosthetic experience, to evaluate their prosthetic components, to rate

aspects of their prosthesis, and to make suggestions regarding design improvements. Some key conclusions were as follows: 14 (56%) reported that sufficient information regarding prosthetic options, adaptive aids, or one handed techniques was not made available to them; 20 (80%) were not satisfied with the "state of the art upper limb prostheses, the lack of available resources, and the prohibitive cost of myoelectric prostheses" (Melendez and Leblanc, 1988, p. 63); of the 18 who had worn a prosthesis previously, 16 or 64% felt they were as or more functional without their prosthesis. When asked what the prosthetic wearers liked most about their prosthesis, 76% cited function, 35% stated symmetry, balance, and body image, and 12% it's reliability. Characteristics of the prostheses that were disliked by the wearers included an uncomfortable axilla/harness or socket, poor appearance, or poor function. These findings are based on a small sample size, and therefore have limited generalizability to the larger population of those with limb deficiencies. However, the findings suggested the importance of availability of resources and the need for

prosthetic design research, so as to better meet the needs of this population, both in a general sense and for specific use in sports.

Scotland and Galway (1983) conducted a study regarding prosthetic wear for those with a congenital or acquired upper limb deficiency through childhood, adolescence, and adult life. Data were gathered through medical records and completion of a questionnaire. There were 131 subjects aged 8 to 25 years. Forty-nine percent of this population had a below elbow limb deficiency. The findings showed that 32% of the total subjects (13% of the 64 subjects with a below elbow limb deficiency) discontinued use of their prosthesis. The discontinuance rate was said to be correlated with the level of amputation. The longer the limb, the less likely the subject was to use a prosthesis. The most successful group of children to fit with the prosthesis were the children with a congenitally acquired short below elbow stump. Their discontinuance rate was 13%. Twenty-two percent of those fitted with a prosthesis before the age of two discontinued

use, whereas 58% who were fitted after the age of two discontinued use. A steady increase in the rate of discontinuance was shown between the ages of 6 to 11 years. The most common reason given by the respondents for discontinuance was that they could manage as easily without it. These findings suggested that early fitting of a child who has a below elbow limb deficiency with a prosthesis promotes more successful incorporation of the prosthesis into activities of daily living.

A study by van Lunteren, van Lunteren-Gerritsen, Stassen, and Zuithoff (1983) was conducted to determine the role a prosthesis has in the life of one with an amputation, in addition to it's use, benefits, and burdens. Subjects included 42 adults 18 years or older with an above or below elbow limb amputation. Data were collected through administering several questionnaires and a semi-structured interview. This study had many conclusions, but only the findings regarding use of the prosthesis are presented. When asked about the type of activities for which the prosthesis was important,

67% of the subjects identified hobbies; 40%, driving or cycling; 33%, work; and 14%, activities of daily living. Several hobbies that were identified for which the prosthesis was useful were gardening, fishing, soccer, tennis/badminton, and shooting. "Some" subjects indicated that they wore their prosthesis during sports, and several wished to have a special cosmetic hand made of a soft material for use in sports. This study had a small sample size, and the subjects were adults. The findings, however, indicated a substantial percentage of those with a below elbow limb deficiency identified their prosthesis as useful in a range of activities. In addition, the quest for a "special cosmetic hand" indicated the need for subsequent prosthetic designs even at the time of this study.

Prosthetic Designs

A variety of "sport specific" prostheses are available which may increase the participant's athletic competence. Successful use of sports prostheses depends upon the

technologic advances in prosthetic design and materials, in addition to the participant's physical fitness and conditioning (Radocy, 1987). Examples of specific prostheses available include the SUPER SPORTS MITT, a passive non-cable activated device which can be used in any ball sport, a terminal device for hockey, composed of an adjustable tension ball socket, or a prosthesis used for swimming that is conducive to water flow and resistance (Radocy, 1987). An upper extremity "sports arm" (Koelker and Senske, 1988) was designed in request to a need for a suitable below elbow prosthesis for football and soccer. This sports arm has no hard parts, could flex in a 3 point stance, and is soft and pliable in all directions. There are also prostheses available for use by children or adults with a below elbow limb deficiency for golf, baseball, fishing, skiing, canoeing, kayaking, and hunting. Such examples provide only a sampling of what is available to date, should a child choose to wear a prosthesis during sports activities.

Current National Regulations for Wearing Prostheses in Sports

The current National Federation of State High School Association rule books for varied sports addressed the wearing of prosthetics during participation in sports. Presented are rules for volleyball, basketball, baseball, and football.

The 1990 rule book for volleyball in Rule 4, section 1, Article 1 stated that "a guard, cast, or brace made of hard and unyielding leather plastic, pliable (soft) plastic, metal, or any other hard substance, even though padded, is not permitted on the finger, hand, wrist, forearm, or elbow" (National Federation of State High School Association [NFSHSA] for volleyball, 1990, p. 13). Article 3 of the same rule and section stated that "artificial limbs are permitted when, in the judgment of the state association, they are: a) no more dangerous than the corresponding human limb, or b) adequately padded" (NFSHSA for volleyball, 1990, p. 13). These two

articles seem somewhat conflicting as the artificial limb can many times be made of a form of "pliable soft plastic." The ruling for participation of a child wearing a below elbow limb prosthesis is therefore left to the discretion and interpretation of the rules by the sport official.

The same statement was found in the basketball rule book in Rule 4-1, Section 5, Article 1 regarding the wearing of a guard, cast, or brace. A subsequent note under the same article reads: "each state association may authorize the use of artificial limbs which in it's opinion are no more dangerous to players than the corresponding human limb, and do not place the opponent at a disadvantage" (NFSHSA for basketball, 1990, p. 19).

The baseball rule is as follows: Rule 1, Section 1, Article 6: "All casts, splints, and braces must be padded. No protective equipment shall have exposed metal or any other hard material. Prostheses may be worn" (NFSHSA for baseball,1990, p. 8). Yet Part 2, Rule 1, Section 1.1.6a refers to the wearing of an artificial leg. This section stated: "the

umpire will decide whether or not the prosthesis (worn) is safe. If it is judged to be hazardous, that player may not compete" (NFSHSA for baseball, 1990, p.7).

Participation in football by a player with a prosthetic arm or leg requires that the coach have a "letter or statement signed by the executive officer of the state association indicating approval of the artificial limb" (NFSHSA for football, 1990-91, p. 16). In addition, Rule 1, Section 1.5.3B. comments: "The prohibition against the wearing of an artificial prosthesis has been modified to permit state associations to authorize use of artificial limbs that meet certain specifications or criteria" (NFSHSA for football, 1990-91, p. 16). The legality of the equipment must be approved by medical authorities and football administrators, and "each case must be handled on an individual basis and each state association determines it's own procedure for approval" (NFSHSA for football, 1990-91, p. 16). There are specific criteria designated to determine the legality and suitability of wearing of a prosthesis. Key points include: hinges and other

hard or unyielding material must be covered and padded; the prosthesis should be covered with a minimum of 1/2 inch high density polyurethane or foam rubber; and approval by an orthopedic surgeon or physician associated with an amputee clinic is recommended (NFSHSA for football, 1990-91, p. 16).

Based on the excerpts from current contact sport rule books, it becomes evident that rulings can be subject to interpretation. The allowance of participation for a child with a below elbow limb deficiency and their prosthesis in a sport is left to the authorization of state school officials and each case is ruled upon individually.

Injury Statistics of Able-bodied Children

The following studies offer data regarding the able-bodied population and injury statistics for comparative purposes. The maturation processes that occur in a child or adolescent can predispose them to injury through participation in sports. The incidence of injury is said to increase with the age and size of

the athlete (Webber, 1989). Growth spurts that each child experiences may be "associated with diminishing strength, agility, coordination, and endurance" (Stanitski, 1989, p. 35) and decreased flexibility, which in turn can predispose one to acute or overuse injuries. Such factors are important to bear in mind when researching injury statistics in children and adolescents. Children with a below elbow limb deficiency and those who are able-bodied are conceptually similar as far as their predisposition to injury based on these facts.

No data has been found regarding statistics of injury of children with a below elbow limb deficiency through participation in sports. Substantial data exist on injury of able-bodied children that occurs in organized sports programs. These studies are presented to illustrate that children, with or without a disability, unfortunately, do injure themselves in sports; and to identify sports in which children are more apt to injure themselves. In comparing data from injury studies, there are variations in injury definition, populations of study, measures of injury severity, risk factor controls, control of

variables, duration of study, and data gathering methods (Goldberg, 1989; Stanitski, 1989). These methodological differences limit comparative conclusions from being drawn. They do, however, provide insight into the frequency and types of sports injuries that occur among able-bodied children.

Zaricznyj, Shattuck, Mast, Robertson, and D'Elia (1980) surveyed public and private schools, community sports programs, schools' accident insurance companies, local physicians, and hospital emergency rooms regarding sports related injuries during a one year period. Of 25,512 school children, 1,495 (6%) reported injuries. The sports with the highest incidence of injuries were football (19%), basketball (15%), gym games (11%), baseball (10%), and rollerskating (6%). Nonorganized sports produced the most injuries (40%), physical education classes reported 38%, organized school sports produced 15%, and community team sports accounted for 7% of the injuries. Findings also indicated that injuries to boys were two times more frequent than injuries to girls.

In a similar study, Gallagher, Finison, Guyer, and

Goodenough (1984) conducted a descriptive epidemiological analysis of injuries of children in sports during a one year period. Subjects of this study were 87,022 Massachusetts children and adolescents under 20 years of age. Twenty-three hospitals were reviewed to collect data on three levels of injury: death, hospitalization, and emergency room treatment. Injury rates were found to be 0.15% for children up to five years, 34% for those aged 6 to 12, and 7% for those aged 13 to 19 years. Injuries as a result of sports participation was the second leading cause reported by the hospitals. Injuries were sustained most often as a result of participation in football (19.9%), basketball (17.4%), rollerskating (13.4%), and baseball (9.4%). In addition, sports were found to be the leading cause of sustained fractures and sprains.

A third study examined children's sports accidents that were treated in hospitals. Kvist et al. (1989) reviewed 6,172 patient records of 6 to 15 year old children during a two year period. It was found that 1,124 diagnoses were sports related. Sixty-nine percent of the injuries occurred to boys, and the

sports in which they were more apt to injure themselves were ice hockey (36%) and football (20%). Girls were more commonly injured in skating (18%) and horseback riding (18%). The number of accidents increased in boys and girls up to the age of 15 years. The proportional occurrence of fractures increased with age in boys ($P<0.001$) and decreased in girls ($P<0.001$). In each of the three studies cited, injuries occurred in similar sports. Each had a large sample size and varied methods of data collection. However, it is difficult to compare the studies due to the variation in injury definition and population characteristics.

The type of sport engaged in appears to dictate the nature of the injuries sustained. Sullivan, Gross, Grana, and Garia-Moral (1980) conducted a study to evaluate the injuries sustained as a result of participation in soccer. Data gathering was conducted through a survey of coaches and parents of 1,272 youth soccer players aged 7 to 18. A total of 34 injuries or 2.6 injuries per 100 participants was reported. Seventeen of the 1,272 injuries were classified as major in

that the player missed more than seven days of practice or play. Most injuries were reported as contusions (38%) or sprains (35%). Findings indicated that those participants aged 14 to 16 reported the most injuries (41.2%) followed by those aged 12 to 14 (20.6%).

There are few studies of injuries sustained as a result of participation in basketball. Chandy and Grana (1985) conducted a three year study of 24,485 boys and 18,289 girls who participated in a variety of interscholastic sports. Data were gathered from the Secondary Schools Injury Registry. The injury rate was found to be 6% for the boy athletes and 8% for girl athletes. The major injury rate (greater than seven days lost) was reported to be 49.13% of the total injuries for boys and 61.09% of the total injuries for girls. Areas of the body that were most frequently injured were the ankle, knee, and leg. Another study by Garrick and Requa (1987) collected information from four high school athletic training departments over a two year period. This study found that the injury rate for boys playing basketball was 31% and 25% for

girls. Forty-one percent of the injuries reported to both boys and girls required a physician's attention.

Participation in football by children and adolescents often results in injury as the nature of the sport entails increased body contact and collision. Goldberg, Rosenthal, Robertson, and Nicholas (1988) studied six Pop Warner football leagues of 5,128 boys aged 8 to 15 years of age. Coaches were asked to keep a roster of all "significantly" injured players for one season. A telephone survey was then conducted of the injured player and his/her parent. Two hundred and fifty-seven injuries (5%) were reported, of which 61.4% were classified as moderate, and 38.9% classified as major. The oldest and heaviest players had the highest overall rate of injury (9.6%). The hand/wrist was reported to be most often injured (27.6%) followed by the knee (18.7%), and the shoulder/humerus (11.3%). Thirty-five percent of the injuries were fractures (of these, 5% were epiphyseal fractures), 24.5% sprains, and 16.7% contusions.

Participation in baseball has been associated with macrotraumatic collision injuries and microtraumatic overuse problems (Goldberg, 1989; Micheli, 1983). Little league shoulder is a sport-affiliated injury resulting from repetitive throwing. Chandy and Grana (1985), in the study cited earlier, found an injury rate of 14.5% per 1,000 athletes (100 injuries for 6,873 participants) for boys, and a 19.2 injury rate per 1,000 athletes for girls (61 injuries out of 3,164). Zaricznyj et al. (1980) found baseball to be the fourth leading sport having incidence of injury (10%), mostly incurred by boys rather than girls. This study reported 43% of the injuries occurred in nonorganized baseball games. This study also stated that injuries to the head most often occurred in baseball activities, but did not list this sport as causing injury to the upper extremity in any of it's participants.

Summary of Literature Review

The human occupational frame of reference reflects the belief that achievement can be facilitated through play and work, and the drive for achievement creates interests, abilities, and skills (Reilly cited in Reed, 1984). Successful occupational behavior is reliant upon participation in a variety of activities as found in the literature review which presented relevant information regarding the child with limb deficiencies, benefits of participation in sports, prosthetic types, and injuries of able-bodied children. Participation in sports was found to have a direct effect on activity levels as an adult, contribute to higher self-esteem, and a positive body image. Those with limb deficiencies were found to have varied preferences for prosthetic use and type, and indicated the need for information as well as advanced prosthetic design. Choice of whether to wear a prosthesis or not was associated with age of fitting of prosthesis, level of amputation, and functional preference. The literature presented several types of prostheses that are sport specific and indicated a need for

clarification of regulations regarding prosthetic wear when engaged in organized sports. Data regarding injuries to able-bodied children as a result of sport participation, showed there were more injuries in the higher contact sports but the type and degree of injuries were not serious for the majority of the population.

Most of the studies presented in this literature review used either questionnaires or interviews to collect the data. These methods appeared to be the best ways to collect data on the aspects of participation in sports and associated injuries thereof. The limitations of these methods were that the findings were based on subjective perceptions of the respondents or medical record statistics.

CHAPTER 3

DESIGN AND METHODOLOGY

The purpose of this study was fourfold: 1) to determine the frequency with which children aged 7 to 18 with a below elbow limb deficiency participate in sports; 2) to identify the sports in which these children more commonly engage; 3) to determine the rate of injuries that occur to this population when participating in organized sports, and 4) to identify whether injuries to able-bodied children have been attributed to children wearing a below elbow limb prosthesis when playing sports. In addition, information was gathered regarding the types of prostheses, padding, and terminal devices worn by children with a below elbow limb deficiency, the wearing patterns of prostheses, and the frequency of damage that occurred to a prosthesis because of participation in sports.

Subject Selection

The sample was drawn from parents or legal guardians of children with a below elbow limb deficiency aged 7 to 18 who have come to one of several amputee clinics. This group was identified from several participating facilities: Lucile Packard Children's Hospital at Stanford, Palo Alto, California; The Institute for Rehabilitation and Research, Houston, Texas; The Area Child's Amputee Center, Grand Rapids, Michigan; Robin Aids Prosthetic Clinic, Vallejo, California; and 17 Shriner's Hospitals for Crippled Children. Consent letters from Lucile Packard Children's Hospital and the Shriner's Hospitals for Crippled Children are included in Appendix A. Remaining hospitals gave verbal consents for the distribution of questionnaires.

Design of the study

This study's design was descriptive and non-experimental using survey methodology. The instrument was a mailed questionnaire written by the examiner. The questionnaire included yes/no or one answer items, and was in booklet form (Appendix B).

Method/Collection techniques

Approval was sought by each facility. Following this, one of two methods was used to distribute the questionnaires depending on the facility's choice. In Method A, the researcher requested a list from each medical records department that included the name and address of each child aged 7 to 18 with a below elbow limb deficiency that had been seen through the facilility's amputee clinic. Upon receipt of this list, the examiner mailed a cover letter explaining the project, a consent form (Appendix C), the

questionnaire, and a stamped envelope to each proposed respondent. In Method B, the researcher mailed a predetermined number of questionnaire packets to the facility based on the number of eligible respondents. A designated staff member was asked to distribute the questionnaire to these parties. The parents were given the option to participate, provided consent information, and insured of the confidentiality of their answers through the cover letter and consent form. Participants were given the option to receive a summary of the study's findings by indicating their address on the consent form.

Statistical techniques

The data gathered were analyzed using descriptive data analysis. Analysis consisted of frequency distribution, mean with standard deviation, median, and mode. The following variables were analyzed: frequency and type of sport participated in by children with a below elbow limb

deficiency; frequency, type, and location of injuries that occurred as a result of participation in organized sports; frequency, type and location of injuries that occurred to able-bodied children by those children wearing a below elbow limb prosthesis; types of below elbow limb prostheses, terminal devices and frequency of padding; wearing patterns of prostheses on a daily basis and when engaged in sports; and frequency of damage that occurred to a prosthesis due to sports participation.

CHAPTER 4

DATA AND RESULTS

Four hundred and twenty questionnaires were mailed directly to parents of children with a below elbow limb deficiency, and 90 questionnaires were sent to participating facilities to be handed out to qualified respondents. One hundred and fourteen questionnaires with valid data were returned from the prospective populations for a 21.0% return. Of the 114 replies, 86 were received reporting children with a below elbow limb deficiency. Of the 86 reported children, 16 had a long below elbow limb deficiency, and 70 children had a short below elbow limb deficiency. Three of the children had multiple levels of amputations, one of which was a below elbow limb deficiency. Other replies came from parents of children with levels of other limb deficiencies: 6 who had a partial hand deficiency, 14 with a wrist level deficiency, 3 with an above elbow deficiency, 1 with a shoulder deficiency,

and 4 with multiple levels of limb deficiencies. Table 1 summarizes the level of limb deficiencies.

Demographic Data

The sample consisted of parents as the respondents for 86 children with a below elbow limb deficiency. Table 2 shows the age distribution of the children, who ranged from 7 to 18 years of age.

There were 46 (53.3%) questionnaires received from parents of male children, and 40 (46.5%) from female children. The respondents surveyed represented 30 states, in addition to one from Mexico, and another from South America. The state of California had the largest representation with 12 respondents (14.0%). Table 3 summarizes data on the state of residence of the respondents.

Table 1
Level of Child's Limb Deficiency (N =114)

Level of Limb Deficiency	n
Below elbow	86
Short below elbow	70
Long below elbow	16
Wrist level	14
Partial hand	6
Multiple	4
Above elbow	3
Shoulder	1

Table 2
Age of Children with a Below Elbow Limb Deficiency (N = 84)

Years of Age	n	Percent
7	3	3.6
8	7	8.3
9	9	10.7
10	6	7.1
11	7	8.3
12	6	7.1
13	13	15.5
14	13	15.5
15	4	4.8
16	6	7.1
17	5	6.0
18	5	6.0

Note. Missing responses = 2.

Table 3
State of Residence of Respondents (N =86)

State / Country	n	Percent
AL	2	2.3
AR	1	1.2
CA	12	14.0
CO	2	2.3
FL	7	8.1
GA	1	1.2
IA	1	1.2
IL	4	4.7
IN	4	4.7
IO	1	1.2
KY	2	2.3
MI	6	7.0
MO	2	2.3
MT	3	3.5
MEXICO	1	1.2
NC	3	3.5
NE	1	1.2
NH	1	1.2
NJ	3	3.5
NV	2	2.3
NY	1	1.2
OH	4	4.7
OR	4	4.7
PA	2	2.3
SOUTHAMERICA	1	1.2
TE	1	1.2
TN	1	1.2
TX	4	4.7
VA	1	1.2
VT	2	2.3
WA	4	4.7
WV	2	2.3

The data and results are presented as answers to each research question.

Question One: In what sports do children with a below elbow limb deficiency aged 7 to 18 participate more frequently?

Seventy-two (83.7%) respondents reported that their children with a below elbow limb deficiency currently played in an organized sports league, or they had in the past, and 13 (15.1%) had not. Table 4 presents data about the sports in which the children with a below elbow limb deficiency participated both currently or those that they played in the past. Of the 86 respondents, the number of participants in each sport is listed as follows: 44 played T-ball/baseball, 41 played basketball, 41 played soccer, 39 participated in swimming, 22 participated in gymnastics or dance, 20 played football, 13 played volleyball, 9 played tennis, 3 played hockey, 1 participated in barrel racing, 1 played golf, and 1 participated in wrestling.

Table 4
Sports Participation (N = 86)

Organized Sports	n
T-ball/baseball	44
Basketball	41
Soccer	41
Swimming	39
Gymnastics/dance	22
Football	20
Volleyball	13
Tennis	9
Hockey	3
Barrel Racing	1
Golf	1
Wrestling	1

Note. Respondents chose as many sports as child participated in.

Question Two: What is the frequency with which children who have a below elbow limb deficiency participate in sports?

Respondents were given choices of length of participation for each sport in which the child participated. Of the 39 children who participated in swimming, 10 (25.6%) did so for up to one year, 6 (15.4%) for 2 to 3 years, and 23 (59.0%) for 3 or more years. Of the fourty-four participants who played baseball or T-ball, 11 (25.0%) played for up to one year, 16 (36.4%) played for 2 to 3 years, and 17 (38.6%) played for 3 or more years. Of the 41 children who played soccer, 16 (39.0%) played for up to one year, 12 (29.3%) for 2 to 3 years, and 13 (31.7%) for three plus years. Thirteen respondents played volleyball. Of these, 3 (23.0%) played one year, 6 (46.2%) played 2 to 3 years, and 4 (30.8%) played for more than 3 years. Of the 20 children who participated in football, 4 (20.0%) played for less than one year, 8 (40.8%) played for 2 to 3 years, and 8 (40.0%) played for 3 or more years. Fifteen (36.0%) children who participated in basketball played for less than one year, 13 (31.7%) played for 2 to 3 years, and 13

(31.7%) played for 3 or more years. Of the 3 respondents whose children played hockey, 2 played for less than one year, none played for 2 to 3 years, and one played for 3 or more years. Of those who played tennis, 3 did so for less than one year, 2 played for 2 to 3 years, and 4 played for 3 or more years. Of those who participated in gymnastics or dance, 9 did so for less than one year, 7 participated for 2 to 3 years, and 6 participated for 3 or more years. The child who reportedly participated in barrel racing has done so for 2 to 3 years. The golf participant has played for 2 to 3 years, and the wrestler for 2 to 3 years.

Question Three: What are the frequency, type, and location of injuries that occur to children with a below elbow limb deficiency as a result of participation in organized sports?

Table 5 presents the frequency of injuries reported, and the sports in which the child was injured. Of the 71 valid cases reported (15 were missing), 60 (84.5%) of children with a below elbow limb deficiency reported that no injury had been sustained. A total of 11 injuries were reported (15.5%). There

Table 5

Frequency of Injuries Reported Within Each Sport (N = 71)

Sports	n
T-ball/baseball	2
Soccer	2
Football	2
Volleyball	1
Basketball	1
Track	1
Wrestling	1
Unspecified	1
No injury	60

Note. Missing responses = 15

were 2 reported injuries occurring in T-ball/baseball, 2 in football, and 2 in soccer. One reported that the child with a below elbow limb deficiency had been injured in volleyball, one in basketball, one in track, and one in wrestling. In addition, one respondent reported injury, but did not report in which sport this occurred.

Of the 11 cases who reported injuries, 3 injuries occurred to the leg , and one injury to the head. The other 6 respondents (54.6%) reported other locations as follows: ankle (n=1), nose (n=1), eye (n=1), groin area (n=1), and neck (n=2). One respondent reported a multiple injury, in the right leg and left knee.

One case reported a cut, scratch, or abrasion type injury, 3 a broken bone, and 5 a sprain or strain. Two responses were reported as "other" which included a bruised eye and torn cartilage.

One reported case stated that the child was hospitalized 1 to 2 days as a result of the injury. Two children reportedly missed school secondary to an injury sustained in sports. Of these two, one missed 1 to 2 days, and the other 3 to 5 days.

Unfortunately, the questionnaire did not specifically ask if the children who had sustained an injury were wearing their prosthesis at the time of injury. It is therefore not known if the prosthesis was instrumental at all in causing the injuries.

Question Four: Are there any similarities between the frequency, type, and location of injuries that occur to children with a below elbow limb deficiency, and the able-bodied population, as a result of participation in sports?

Data regarding the stated frequency, type, and location of injuries in the children with a below elbow limb deficiency will be compared to the able-bodied population in the Discussion section.

Question Five: What are the frequency, type, and location of injuries that occur to same aged able-bodied children which have been or can be attributed to children wearing a below elbow prosthetic device during participation in organized sports?

There were four reported injuries that occurred to able-bodied children. One child was injured in gymnastics or dance,

one in football, one in basketball, and the other in baseball. (There were 73 valid cases and 13 missing responses). The location of the injuries were reported in 3 of the 4 cases. One child was injured in the right arm, and two children in the head. Of the four children who were injured, two specified the type of injury. Both children reported as sustaining cuts. One of the two specified in the head, the other did not specify location. The four reported cases did not require hospitalization for their injuries.

Respondents were asked if they felt that the prosthesis worn by the children with a below elbow limb deficiency was instrumental in causing injury to the able-bodied children. Of the four cases, three (75.0%) reported that, yes, they felt the prosthesis was the cause of injury.

Again, the type of prosthesis worn by the child during participation in sports is not known. Therefore, no information can be offered regarding which prosthesis may have caused the injury to the able-bodied children. It is known that none of the prostheses were padded at the time of injury.

Question Six: What are the types of below elbow prostheses and terminal devices owned by children, and what is the frequency of padding of prostheses when engaged in sports activities?

Data were collected regarding the types of prostheses and terminal devices owned by the children with a below elbow limb deficiency on a daily basis and when participating in sports. In addition, information was gathered regarding padding of a prosthesis when playing sports.

The types of prostheses most frequently owned by children with a below elbow limb deficiency is presented in Table 6. Thirty-five (40.7%) had a voluntary opening hook, 32 (37.2%) had a myoelectric prosthesis, 31 (36.0%) had a cosmetic hand, 17 (19.8%) had a voluntary closing hook, and 2 (2.3%) owned a CAPP type prosthesis. Thirty-three children (38.4%) reported having multiple prostheses. Of the 86 children, 8 (9.3%) reported that they did not own a prosthesis. One case did not specify if the child had a prosthesis.

Respondents were asked to qualify if the child with a below

Table 6

Types of Prostheses Owned by Children with a Below Elbow Limb Deficiency (N = 86)

Type of Prosthesis	n	Percent
Voluntary opening hook	35	40.7
Mechanical hand	32	37.2
Cosmetic hand	31	36.0
Voluntary closing hook	17	19.8
CAPP	2	2.3
No prosthesis worn	8	9.3
Multiple prostheses worn	33	38.4
Unspecified	1	1.2

elbow limb deficiency wears a special prosthesis or terminal device specifically when in sports, and if so, what type. Table 7 presents these responses. Twelve children (16.2%) with a below elbow limb deficiency wore a special prosthesis or terminal device, and 62 (83.8%) did not. Of those who did wear a special prosthesis or terminal device when participating in sports, 6 used a sport mitt. One child wore a cosmetic hand. One subject used a "sports arm which was specially padded". One other child had a golf attachment terminal device. One child reported playing T-ball with a voluntary opening hook which was adapted through adding an additional straight piece to fit into the fingers of a mitt. One child reported having multiple terminal devices which included a baseball terminal device, and a farmhook. One child reported using a ski hand. The respondents were asked if their children padded their prosthesis when playing sports. Of the 12 valid cases, 10 (83.3%) did pad the prosthesis. The sports in which the children participated when padding their prostheses were football, T-ball/baseball, soccer, basketball, and gymnastics

Table 7

Special Prosthesis or Terminal Device worn by Children in Sports (N = 12)

Type of prosthesis/terminal device	n
Sport Mitt	6
Ski hand	1
Cosmetic hand	1
Sports arm	1
Golf attachment	1
Multiples	1
Adapted voluntary opening hook	1

and dance. Two respondents did not specify in which sport they wore a padded prosthesis.

Question Seven: What are the wearing patterns of prostheses by children with a below elbow limb deficiency both on a daily basis and when engaged in sports activities?

Prosthetic Wear on a Daily Basis

Table 8 presents the data regarding wearing patterns of a prosthesis on a daily basis. Thirty-one children (36.0%) reported wearing their prosthesis for more than 10 hours a day. Seventeen children (19.8%) wore the prosthesis for less than 10 hours a day. Seven children (19.1%) reportedly wear the prosthesis several times a week. Five children (5.8%) were reported as wearing their prosthesis a few times a month. Eight children (9.3%) wear the prosthesis a few times a year, and 18 or 20.9% reported as never wearing a prosthesis.

Sample data were examined to see if there were any relationships between age and the frequency with which a child with a below elbow limb deficiency wore a prosthesis. The ages 7, 10, 15, and 18 years were examined. Of the three

Table 8
Frequency with which Children with a Below Elbow Limb Deficiency Wear Their Prosthesis (N = 86)

Amount of time	n	Percent
10 + hours / day	31	36.0
<10 hours / day	17	19.8
Several times / week	7	8.1
Several times / month	5	5.8
Few times / year	8	9.3
Never	18	20.9

children aged 7 years, 66.7% of them wore their prosthesis less than 10 hours a day and 33.3% for more than 10 hours. Of the six children aged 10, 33.3% wore a prosthesis for more than 10 hours, 16.7% less than 10 hours, 16.7% a few times a month, 16.7% a few times a year, and 16.7% not at all. Of the four children age 15, 25.0% wore the prosthesis more than 10 hours a day, 25.0% several times a week, and 50.0% not at all. Of the five 18 year olds, 40.0% wore a prosthesis for more than 10 hours a day, 20.0% less than 10 hours a day, 20.0.0% a few times a year, and 20.0% not at all.

Gender was also compared to frequency with which a child with a below elbow limb deficiency wore their prosthesis. 58.1% of males wore their prosthesis more than 10 hours a day as compared to 41.9% of of the population that were females. Males who wore the prosthesis for less than 10 hours a day comprised 47.1% of the population as compared to 52.9% females. Of those that wore the prosthesis several times a week, 42.9% were males, and 57.1% were females. Forty percent males wore the prosthesis a few times a month as compared to 60% females. Of those that never wore the

prosthesis, 38.9% were male, and 61.1% female.

Respondents were asked if the prosthesis currently fits the child. Of the 86 children, 70 (81.4%) stated that the prosthesis does currently fit the child. Sixteen or 18.6% reported that the prosthesis does not fit the child.

Wearing Patterns of Prostheses when Engaged in Sports Activities

Data were collected regarding prosthetic wearing patterns by children with a below elbow limb deficiency when engaged in specific sports. The years of participation of the child in each sport was identified as well. Of those 39 children who claimed to have participated in swimming, 4 (10.3%) wore a prosthesis, and 35 children (89.8%) did not. Table 9 represents data regarding years of participation of those children who wear a prosthesis when swimming and of those who do not. Of the 39 who participate in swimming, one child (2.6%) has done so for up to one year with a prosthesis. Two cases (5.1%) reported having participated in swimming 2 to 3 years with a

Table 9

Years of Participation in Swimming With and Without Use of Prosthesis (n = 39)

Years Participated / Prosthesis	n	Percent
1 yr. with prosthesis	1	2.6
2-3 yrs. with prosthesis	2	5.1
3+ yrs. with prosthesis	1	2.6
1 yr. without prosthesis	9	23.1
2-3 yrs. without prosthesis	4	10.3
3+ yrs. without prosthesis	22	56.4

Note. Missing responses = 47

prosthesis. One child (2.6%) reported wearing a prosthesis for a participating time of 3 or more years. Nine children (23.0%) swam for one year without a prosthesis, four children (10.3%) for two to three years without a prosthesis, and 22 cases (56.4%) swam three years without a prosthesis.

Of the 44 children with a below elbow limb deficiency who reportedly participate in T-ball/baseball, 18 (40.9%) played with a prosthesis and 26 (59.1%) did not wear a prosthesis when playing. Table 10 represents data regarding years of participation in T-ball/baseball of those who wear a prosthesis and of those who do not. Three children (6.8%) have played this sport with a prosthesis for one year, eight (18.2%) for two to three years with a prosthesis, and seven (15.9%) for three or more years with a prosthesis. Of those who did not wear a prosthesis, eight children (18.2%) have played T-ball/baseball for one year, eight (18.2%) for two to three years, and 10 or 22.7% for more than three years.

Table 10

Years of Participation in T-ball/Baseball With and Without Use of Prosthesis (n = 44)

Years Participated / Prosthesis	n	Percent
1 yr. with prosthesis	3	6.8
2-3 yrs. with prosthesis	8	18.2
3 + yrs. with prosthesis	7	15.9
1 yr. without prosthesis	8	18.2
2-3 yrs. without prosthesis	8	18.2
3 + yrs. without prosthesis	10	22.7

Note. Missing responses = 42

Of the 41 children with a below elbow limb deficiency who participate in soccer, 15 (36.6%) wore a prosthesis and 26 (63.5%) did not. Table 11 represents data regarding years of participation of children in soccer of those who wore a prosthesis and those who did not. Six children (14.6%) wore a prosthesis for one year, 5 (12.2%) for two to three years, and 4 (9.8%) for more than three years. Of those who reported not wearing a prosthesis, 10 (24.4%) had played for one year, 7 (17.1%) for two to three years, and 9 (22.0%) for more than three years.

Of the 13 children with a below elbow limb deficiency, 6 (46.2%) played volleyball with a prosthesis, and 7 (53.9%) played without. No respondents played volleyball with a prosthesis for up to one year. Four cases (30.8%) played with a prosthesis for two to three years, and 2 (15.4%) played for more than three years. Of those who reported not wearing a prosthesis, 3 (23.1%) played for one year, 2 (15.4%) played for two to three years, and 2 (15.4%) played for more than three years.

Table 11

Years of Participation in Soccer With and Without the Use of a Prosthesis (n=41)

Years participated / Prosthesis	n	Percent
1 yr. with prosthesis	6	14.6
2-3 years with prosthesis	5	12.2
3 + yrs. with prosthesis	4	9.8
1 yr. without prosthesis	10	24.4
2-3 yrs. without prosthesis	7	17.1
3 + yrs. without prosthesis	9	22.0

Note. Missing responses = 4

Of the 20 children with a below elbow limb deficiency who reported playing football, 5 (25.0%) played with a prosthesis, and 15 (75.0%) played without. No children participated in football for up to one year with a prosthesis. Two subjects (10.0%) played with a prosthesis for two to three years, and 3 subjects (15.0%) played three or more years with a prosthesis. Of those who played without a prosthesis, 4 children (20.0%) played for up to one year, 6 children (30.0%) played for two to three years, and 5 (25.0%) played for more than three years.

Of the 41 cases who reported playing basketball, 11 (26.8%) played with a prosthesis, and 30 (73.2%) played without a prosthesis. Table 12 presents data about years of participation in basketball of those who wore a prosthesis and of those who did not. Three cases (7.3%) played basketball for up to one year with a prosthesis, 4 (9.8%) played for two to three years, and 4 (9.8%) for three or more years with a prosthesis. Of those children who did not wear a prosthesis, 12 (29.3%) played basketball for up to one year, 9 (22.0%) for two to three years, and 9 (22.0%) for more than three years.

Table 12

Years of Participation in Basketball With and Without the Use of a Prosthesis (n = 41)

Years Participated / Prosthesis	n	Percent
1 yr. with prosthesis	3	7.3
2-3 yrs. with prosthesis	4	9.8
1 yr. without prosthesis	12	29.3
2-3 yrs. without prosthesis	9	22.0
3 + yrs. without prosthesis	9	22.0

Note. Missing responses = 45

Of the three reported cases of children who played hockey, all three played without a prosthesis. Two children (66.7%) had played hockey for one year, and one child for more than three years (33.3%).

Of the nine cases of children with a below elbow limb deficiency who had participated in tennis, 5 had played with a prosthesis and 4 played without a prosthesis. One case (11.1%) played for two to three years with a prosthesis, and four cases (44.4%) played for more than three years with a prosthesis. Three children (33.3%) played for one year without a prosthesis, and one child (11.1%) played for two to three years without a prosthesis.

Of the 22 cases who reportedly participated in gymnastics or dance, 9 (40.9%) did so with a prosthesis, and 13 (59.1%) participated without. Table 13 presents data regarding length of participation in gymnastics/dance by children with a below elbow limb deficiency of those who wore a prosthesis, and of those who did not. Two cases participated in gymnastics or dance for one year with a prosthesis, 3 for two to three years

Table 13

Years of Participation in Gymnastics / Dance With and Without the Use of a Prosthesis (n = 22)

Years Participated / Prosthesis	n	Percent
1 yr. with prosthesis	2	9.1
2-3 yrs. with prosthesis	3	13.6
3+ yrs with prosthesis	4	18.2
1 yr. without prosthesis	7	31.8
2-3 yrs. without prosthesis	4	18.2
3+ yrs. without prosthesis	2	9.1

Note. Missing responses = 64

with a prosthesis, and 4 for more than three years. Seven children participated in gymnastics or dance without a prosthesis for up to one year, four for two to three years, and two for more than three years without a prosthesis.

One child who participated in barrel racing has done so for two to three years and wears a prosthesis. One child reportedly plays golf, and has done so for two to three years with a prosthesis. One child reported participating in wrestling for two to three years, but does not wear a prosthesis.

Question Eight: What is the frequency with which a child with a below elbow limb deficiency has damaged a prosthesis due to participation in organized sports?

A total of 10 cases (13.9%) had damaged their prosthesis secondary to playing in sports, and 62 (86.1%) had not. Five cases (6.9%) had damaged the prosthesis in baseball, one in football (1.4%), two in gymnastics or dance (2.8%), and one in track (1.4%). One case (1.4%) had damaged a prosthesis in multiple sports, once in baseball, and once when weightlifting.

CHAPTER 5

DISCUSSION, PROFESSIONAL IMPLICATIONS, AND SUMMARY

The discussion of the results is presented relative to each research question.

Question One:In what sports do children with a below elbow limb deficiency participate more frequently?

Of the 86 children reported, the majority had participated in some type of organized sports, indicating that the population on the whole enjoys some type of sports activity. The sports in which children more frequently participated were (in descending order): T-ball or baseball, basketball, soccer, swimming, gymnastics or dance, football, volleyball, tennis, hockey, barrel racing, golf, and wrestling. The sports reported for most participants were fairly high contact sports. This may indicate that the population of children with a below elbow limb deficiency do not consider participation a risk or

their limb deficiency limiting in contact sports.

Question Two: What is the frequency with which children who have a below elbow limb deficiency participate in sports?

The majority of children who reported participating in swimming, baseball, soccer, and tennis had done so for three or more years. An equal number of participants played in football and basketball for two to three years as those who participated for more than three years. Volleyball participants and those who did barrel racing, played golf, and wrestled had done so for two to three years.

The occupational behavior frame of reference states that the drive for achievement creates interests, skills, and abilities. It can be speculated from the data that the longer a child played a sport, the higher his/her enjoyment level and skill proficiency within that sport might be. However, it was difficult to determine if the frequency of participation of a child with a below elbow limb deficiency in sports was related to age of the child, availability of the sport, or parameters about the sport that are complimentary to the

child with a limb deficiency. The length of time that these children have spent playing in these sports does suggest that they have encountered few, if any, barriers that may have disrupted participation.

Question Three: What are the frequency, type, and location of injuries that occur to children who have a below elbow limb deficiency as a result of participation in organized sports?

The data indicated that the incidence of injury to children with a below elbow limb deficiency as a result of sports participation was low. Of the 11 subjects reporting an injury, the majority of children incurred the injury while playing baseball/T-ball, soccer, and football. Although the sports that were chosen by this population may possess a higher potential for injury as they are contact sports, the child with a below elbow limb deficiency still chooses to participate.

Of those who reported injuries, locations included the legs, head, ankle, nose, eye, neck, and groin area. Of note is the fact that no respondents reported injury occurring to the upper extremities.

Parental comments on the questionnaire gave insight into other sports injuries. One child had been injured skiing when he came down on a ski pole held in his prosthesis. Another expressed the concern of her child who refuses to play organized sports due to fear of injury. He has chosen instead to snow ski and scuba dive.

Question Four: Are there any similarities between the frequency, type, and location of injuries that occur to children with a below elbow limb deficiency and the able-bodied population, as a result of participation in sports?

Studies regarding injury occurrence in the able-bodied population have reported similar findings to those found in this study and are presented for comparison. However, as methodological differences are prevalent, no inferences may be drawn.

Zariczny, et al. (1980) found that the sports with the highest incidence of injury for children were football, basketball, gymnastics, and baseball. Gallagher et al. (1989) found football, basketball, rollerskating, and baseball to be

sports with a high incidence of reported injuries. This study identified T-ball/ baseball, football, and soccer as sports having the most injuries. This may demonstrate that the sports mentioned have similar injury-risk properties for the able-bodied and children with limb deficiencies.

Studies regarding location of injuries present data as conceptually similar to that found in this study. Chandy and Grana (1985) found areas of the body most frequently injured in children as a result of participation in sports to be the ankle, knee, and leg. Goldberg et al. (1988) found that the hand/wrist was the location of most injuries for their study, followed by the knee, then shoulder, and humerus. Zaricznyj et al. (1980) found injuries most often occurred to the head for those who participated in baseball. Several studies have reported similar data regarding type of injuries sustained in able-bodied children. Goldberg et al. (1989) and Micheli (1983) reported that participation in baseball tends to cause overuse injuries. Goldberg et al. (1989) also found that the most common type of injuries which occurred in their able-bodied

subjects were fractures, sprains, and contusions. Again, the type of reported injuries sustained by children with a below elbow limb deficiency were similar to these studies' findings. There was no indication that the child with a below elbow limb deficiency is at risk for different or more severe injury than the able-bodied child.

Question Five: What are the frequency, type, and location of injuries that occur to same aged able-bodied children which have been or can be attributed to children wearing a below elbow limb prosthetic device during participation in organized sports?

From the data analysis, four injuries to able-bodied children were reported that occurred while playing with a child wearing a prosthesis. These children were injured in gymnastics, football, basketball, and baseball, all sports previously noted to have a higher injury rate, both for able-bodied children and for those with limb deficiencies. Of the four children's parents, three felt the injury could be attributed to their child's wearing a prosthesis.

Unfortunately, the type of prosthesis worn at the time of injury is not known. It is, however, known that none of the prostheses were padded. It cannot be determined whether it was the nature of the sport that caused the child to be injured, or the fact of a child playing with a prosthesis that caused the injury, or whether both factors could be causative.

Question Six: What are the types of below elbow prostheses and terminal devices owned, and what is the frequency of padding of prostheses when engaged in sports activities?

Of the children with a below elbow limb deficiency who had prostheses, the voluntary opening hook was reported as the most common type of prostheses owned, followed by a myoelectric, cosmetic hand, voluntary closing hook, then CAPP. Since close to 40% of the children reported having multiple prostheses from which to choose depending on the type of activity in which they were involved, there is a need for prosthetic options and resources to be made available to all those who choose to wear a prosthesis.

Of those children who reported wearing a special prosthesis or terminal device when participating in sports, the majority used a sport mitt. Reasons for choice of prosthesis were not gathered in this study. However, other studies have cited cosmesis, function, symmetry, balance, and body image as primary reasons for choosing to wear a prosthesis (Krebs, 1988; Melendez & Leblanc, 1988; van Lunteren et al., 1983). For sports and other activities, some wearers have found a body powered type of prosthesis with a harness to be a better choice than a myoelectric prosthesis because of decreased damage potential, increased fine motor skills, better sight of the object to be manipulated, the light weight, and easier cleaning. Terminal devices especially designed for sports activities may well be the most accommodating for the talents needed in each sport, but costs can be prohibitive.

The choice of whether or not to wear a prosthesis in sports is yet another parameter to consider. The child may well find that increased sensation and proprioception, learned accommodating movements, including balance and bimanual

coordination, and lack of a harness which can be impinging are reasons to play without a prosthesis. Comments from respondents offered further reasons, which included: "wearing a prosthesis was not comfortable; the prosthesis was heavy; it does not feel real; lack of control was felt; do not need a device to do things; performance is better without prosthesis; and feelings of self consciousness when prosthesis is worn."

For those who wear a prosthesis in sports, padding is an option to increase safety for self and others. A majority of the respondents padded their prostheses when engaged in football, baseball/T-ball, soccer, basketball, and gymnastics or dance. Information was not gathered about types of padding, although one respondent reported using two shin guards to cover the socket of the prosthesis. Current national regulations regarding prosthetic wear in sports require or suggest padding in varied sports. The general consensus based on interpretation of the rule books is that the child is allowed to play if the prosthetic limb is no more dangerous to players than the corresponding limb and does not place the opponent at

a disadvantage (NFSHSA for basketball, 1990). Only one respondent offered an example of a child who was restricted from a soccer game based on wearing a prosthesis which was not padded. Neither the parents nor the coach were aware of this ruling. One parent commented that she felt the prosthesis itself was no more dangerous than a bony prominence or helmet. This parent felt that her child had been subjected to prejudice in rulings secondary to the wearing of a prosthesis. Reasons for padding, types of padding, and cases of restriction were not gathered in this study but are worthy issues to examine. It is surmised that padding by the respondents was either a voluntary choice or a reinforced option.

Question Seven: What are the wearing patterns of prostheses by children with a below elbow limb deficiency both on a daily basis, and when engaged in sports activities?

Wearing Patterns of Prostheses on a Daily Basis

Of the children with a below elbow limb deficiency, a majority wore a prosthesis on a daily basis. There are many factors that may explain a child's choice of how often to wear

a prosthesis. Several studies have found a relationship between the age at which the child was fitted with a prosthesis, the level of the amputation of the child, and the success rate of prosthetic wear (Melendez & Leblanc, 1988; Scotland & Galway, 1983). Data in this study indicated a possible relationship between age and prosthetic wearing patterns. As the children became older, there was a slight decrease in number of those who wore their prosthesis for 10 or more hours a day. Several parents commented that their child wore the prosthesis until the adolescent years, then the amount of wearing time decreased. Current literature suggests that children with short below elbow limb deficiencies are found to be the most frequent wearers of prostheses. The majority of children in this study have a short below elbow limb deficiency, perhaps a contributing factor for the finding that a significant number wear a prosthesis for most of the day. Parental comments offered some insight into reasons for prosthetic wear. Cosmesis and function were said to be important to the child and parent. One parent commented

that the child only wore a prosthesis for special occasions and cosmesis. Another child wore the prosthesis daily, but not for sports. Several parents commented that their child found as they got older that they could perform more activities without a prosthesis. Most parents indicated that the decision was left to the child regarding whether or not to wear a prosthesis, and how often, but some seemed to feel that their child would benefit from prosthetic wear, even if the child was resistant to the idea. Research has indicated that prosthetic choice is based on function.

The frequency and longetivity of prosthesis wear is also dependent upon the fit of the prosthesis and harness. The majority of children had a prosthesis that fit. It cannot be determined from this study if children had chosen not to own a prosthesis or if they did not own one for other reasons. In addition, it cannot be determined if the fit of the prosthesis was related to the child's choice not to wear it. Implications for close follow up by therapists and prosthetists of the growing child is inherent, with an appropriately sized

prosthesis the goal for function.

Wearing Patterns of Prostheses when Participating in Sports

The wearing patterns of a prosthesis and length of participation by a child with a below elbow limb deficiency was examined for each specific sport. Of those sports discussed, the majority of children chose to wear a prosthesis when participating in tennis, barrel racing, and golf. A majority of children chose not to wear a prosthesis when participating in the following sports: swimming, baseball/T-ball, soccer, football, basketball, dance or gymnastics, and wrestling. In volleyball, there were prosthetic wearing and non-wearing participants. The majority of children who participated in swimming did not wear a prosthesis and had swam for more than three years. This may suggest that of those children in this study, most found it more functional to swim without a prosthesis, and that chances are they became more adept at the sport without a prosthesis. Of the children

who played T-ball or baseball, a slight majority played without a prosthesis. There did not appear to be any relationship between length of participation and choice to wear a prosthesis or not. Several parents commented that their children initially wore a prosthesis when playing baseball, but eventually chose not to wear it as their skill developed.

Of those children who participated in soccer, the majority had done so for more than three years and did not wear a prosthesis. This suggests that the children in this study found it more functional to play without a prosthesis than with one. One parent commented, "aside from occasional ball handling, soccer does not require a lot of upper extremity movements and manipulations," thus making a prosthesis unnecessary for the sport.

Of the children who played volleyball, almost the same number of children played with a prosthesis as without. As the sample size of volleyball participants was small, it is difficult to establish any trend or relationship between

wearing of a prosthesis and length of participation, aside from personal preference. One parent commented that the prosthesis worn by her child gave her increased balance in this sport.

Of those children who played football, a majority did so without a prosthesis for up to three or more years. As football is a high contact sport, regulations based on safety issues may have had an impact on the choice of wearing a prosthesis in this sport. Other reasons may include complications in the padding of a prosthesis, increased agility without a prosthesis, or simply personal choice. Perhaps these are the same reasons why a majority of the children who played basketball did so without a prosthesis. Of those who played hockey, all did so without a prosthesis and the majority had done so for up to one year, possibly suggesting that skill in this sport does not require prosthetic wear. The majority of children who played tennis did so with a prosthesis, and of those, a majority had done so for more than three years. As tennis is not a contact sport, and the majority in this study

wore a prosthesis, it may be suggested that these children found their skill level to be enhanced with prosthetic wear. The prosthesis may offer balance of extremities through swing follow through or increased control in grasp of ball. Of those children who participated in dance or gymnastics, the majority did so without a prosthesis, but a majority who had participated for more than three years had done so wearing a prosthesis. Prosthetic wear in gymnastics may offer a child increased symmetry and balance, yet a child will accommodate his/her movements and techniques to the limb deficiency. Those who participated in dance may have found that no prosthesis was needed. In these activities, personal choice may play more of a role in prosthesis wear than current regulations.

The child who reported as a participant in barrel racing wears a prosthesis, and has done so for two to three years, as has the child who plays golf. Both of these children may have found functional ability was reason enough to wear a prosthesis as the nature of both sports lend to bimanual upper

extremity use. The child who reported as participating in wrestling has done so for two to three years without a prosthesis. As wrestling is a high contact sport, possibly regulations in addition to personal choice and functional ability guided the child in choosing not to wear a prosthesis.

Reasons were not collected regarding why children did or did not wear a prosthesis specifically, or if any child was restricted from play based solely on prosthetic wear. One parent's comment was particularly effective in summarizing her child's experience and some prejudice felt against participation in sports because of prosthetic wear: "...we have come to believe that injuries to a handicapped child playing contact sports are, for the most part, emotional." This parent's child was restricted from play on one occasion because she was wearing a prosthesis.

Question Eight: What is the frequency with which a child with a below elbow limb deficiency has damaged a prosthesis due to participation in organized sports?

The nature of both contact and non-contact sports is such

that those who participate while wearing a prosthesis may be subjected to forces that may damage it. The majority of respondents who had participated in sports while wearing a prosthesis did not damage it. The majority of children had damaged their prosthesis in baseball/T-ball. The types of known prostheses damaged in play included a mechanical hand, voluntary opening hook, and a voluntary closing hook. Current prosthetic designs are changing and evolving to meet the needs of the limb deficient child and adult. Adaptations and modifications are being developed to accommodate those involved in a variety of activities, especially sports. Information is not readily available regarding whether padding a prosthesis decreases the chances of damaging it, or if certain designs are more safe and durable for sports activities. Several parents commented on the need for development of prosthetic design, suggesting that, "the myoelectric should be built a little stronger to stand up to children's play," "better usefulness would be good," and one requested ". . . more ventilation and comfortability." One

parent felt it important to have the prosthesis match the weight of the other arm vs. having advanced function.

Professional Implications and Recommendations

Occupational therapists are often the health professionals who educate the child with a limb deficiency and their parents about sports and recreational aids and techniques. Therapists need to understand the risks and benefits of such activities as well as preferred prosthetic choice and wearing patterns.

Children who participate in sports are predisposed to injuries throughout the growing years secondary to changes in agility, strength, coordination, endurance, and decreased flexibility (Stanitski, 1989), and by the nature of the sport itself. Children with a below elbow limb deficiency are not at greater risk to injure themselves than able-bodied children. It was found that a small percentage of the population injured themselves in organized contact sports. Several instances were reported where children with a below elbow limb

deficiency had injured an able-bodied child while engaged in a contact sport. Based on this study's findings, it became apparent that injuries occur to children with a below elbow limb deficiency who participate in sports, and can occur to able-bodied children as a result of a prosthesis. However, none of the injuries were serious and it cannot be determined that the participation of a child with a prosthesis in a sport increases the chance of injury to themselves or others. Parents, health professionals, and sports officials should encourage children with a below elbow limb deficiency to participate in sports either with or without a prosthesis based on the child's choice and ability. Chance of injury should not negate participation.

Children with a below elbow limb deficiency wear a variety of prostheses. In addition, these children choose not to wear a prosthesis for varied activities and claim function as similar if not better than with a prosthesis. It becomes important for those professionals involved with the children to offer them all options so that they have information upon which to make

choices.

The majority of children with a below elbow limb deficiency reported wearing their prosthesis on a daily basis. Follow up by occupational therapists and prosthetists as the child grows may be indicated to make the child aware of the prosthetic and non-prosthetic options. Several parents commented on the value of early prosthetic use training and follow through by their occupational therapist. It seems that a child should be encouraged to approach all activities in the most functional pattern possible. Early fitting of a prosthesis and use training gives a young child the information upon which to base a choice of whether to wear a prosthesis or not.

The nature of each sport seemed to dictate whether or not the child chose to wear a prosthesis when participating. Some factors the child may consider include: bimanual skills, reach, postural balance, sensory feedback, and object manipulation skills with and without a prosthesis. Awareness of a child's skill level, the characteristics of the sport engaged in, and available prosthetic options, were indicated.

There were a small number of children who damaged a prosthesis while participating in sports. The severity of the damage to the prosthesis was not studied. Advance in prosthetic design and materials used to fabricate prostheses are inherent to the industry so that damage potential is decreased and functional use improved. With this comes the need to clarify issues, rules, and regulations regarding participation of a child with a prosthesis in all sports.

Occupational therapy, as guided by the occupational behavior model, is practiced on the belief that occupational behavior and achievement are developmentally acquired, and can be facilitated through engaging in activities of play, school, and recreation. The occupational therapist can be a key figure in enabling a child with a limb deficiency to experience the benefits of such activities as sports through education, resources, and use training. Relevant data and information regarding issues a child with a below elbow limb deficiency has in addition to their sports participation, can assist this provision. This study gathered baseline data, yet indicated the

need for further research regarding: characteristics and frequency of injuries in the limb deficient and able-bodied populations, types of prostheses worn everyday and in sports and reasons for preference, advantages and disadvantages of wearing a prosthesis during sports, types of padding of prostheses, damage of prostheses, and instances of restrictions or rulings which a child with a below elbow limb deficiency may have encountered.

Summary

The purposes of this study were to collect data about participation in organized sports by children with a below elbow limb deficiency, to determine the rate of injuries that occur to this population when participating in organized sports, and to identify prosthetic use and wearing patterns. Questionnaires were sent to parents of children aged 7 to 18 with a below elbow limb deficiency. Descriptive techniques were used to analyze the data.

Of the 114 questionnaires returned with valid data, 86 responses were from parents of children with a below elbow limb deficiency. The majority of the population participated in one or more sports. The data indicated that a small percentage of the population had been injured. The findings regarding injuries in this study of children with a below elbow limb deficiency were similar to those cited in studies regarding the able-bodied population. The risk of injury to this population appeared to be no higher than for able-bodied children who participate in sports. A small number of able-bodied children were injured by those wearing a prosthesis. Of the children with a below elbow limb deficiency, the majority were reported to own a prosthesis, to wear a prosthesis on a daily basis, and to have a prosthesis which currently fit. A small number of the population wore a prosthesis when engaged in an organized sport, of which several were padded. Several children with a below elbow limb deficiency had damaged their prosthesis as a result of participation in sports.

Results of this study determined that a majority of

children with a below elbow limb deficiency are active in a variety of sports, are no more predisposed to injuries than the able-bodied population as a result of participation, and choose to wear either a variety of prostheses or no prostheses at all, both on a daily basis and in sports. It seems that parents, occupational therapists, prosthetists, sports officials, and others can safely encourage this population to be active in sports, and offer children the opportunities to do so.

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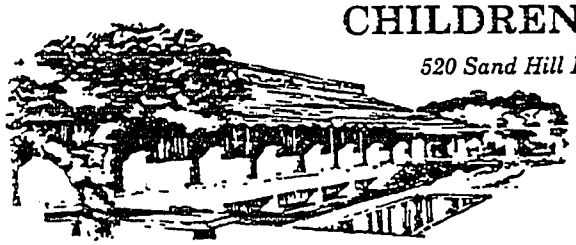
APPENDIX A

CONSENT LETTERS FROM

PARTICIPATING FACILITIES



CHILDREN'S HOSPITAL at Stanford

520 Sand Hill Road, Palo Alto, California 94304 / (415) 327-4800

October 17, 1990

Kristin Syms
120 Troon Way
Half Moon Bay, California 94019

Dear Kristin:

I am looking forward to collaborating with you for a survey of prosthetic wear by below elbow amputees during sports activities. This study will be useful in determining the physical risks to below elbow amputees during participation in organized sports, as well as the risks the amputee poses to able-bodied children as a result of wearing a prosthesis.

After you have obtained approval of your department and the Human Subjects Committee at San Jose State, we can submit the proposal to the Children's Hospital Human Subjects Committee for approval.

I look forward to hearing from you again soon.

Sincerely,

Deborah Bolding

Deborah J. Bolding, M.S., O.T.R.

Shriners Hospitals

P.O. Box 31356, Tampa, Florida 33631-3356 (813) 281-0300

NEWTON C. McCOLLOUGH, III, M.D.
Director of Medical Affairs

March 27, 1991

Ms. Deborah J. Bolding, M.S., O.T.R.
Children's Hospital of Stanford
520 Sand Hill Road
Palo Alto, CA 94304

Dear Ms. Bolding:

This is in reply to your letters of March 18, and March 20, 1991, with respect to your proposed studies of below elbow amputees between 7 and 18 years of age and arthrogrypotic patients over the age of 18. It is my understanding that you seek the names and addresses of the above categories of patients from all Shriners Hospitals.

I endorse and approve of these studies. For medical/legal reasons, it will be necessary for the San Francisco Unit to request this information and it will also be necessary that all correspondence or contacts with other Shrine Hospitals and with patients of Shriners Hospitals be made by employees of the San Francisco Unit. I do realize that you are the principal investigator in these studies and that Kristin Syms, OTR, at the San Francisco Unit will be collaborating with you in the below elbow amputee study, and that Dr. Preston James will be collaborating with you in the arthrogrypotic study. Requests for the information you seek should be made by these two individuals directly to my office and should carry the endorsement of the Chief of Staff of the San Francisco Unit.

Once these requests have been received, we can begin the computer search which should take some six to eight weeks due to the backlog of work in our medical information system office. We will be unable to provide you with mailing addresses from the Headquarters. We will be able to provide medical record numbers for the category of patients by SHCC unit. It will then be the task of the San Francisco Hospital personnel to contact the other units and request current mailing addresses.

By copy of this letter, I am notifying Dr. Skinner, Dr. James, and Ms. Syms of your request and the requirements to be met.

I further understand that any presentations or publications based upon this work will carry appropriate credit to Shriners Hospitals.

I wish you well with your studies and would appreciate learning of the results of your investigations.

With best wishes and kindest regards, I remain,

Sincerely yours,

Newton C. McCollough, III, M.D.

te

cc: Stephen R. Skinner, M.D.
Preston James, M.D.
Kristin Syms, CTR
Kathy Achorn
Kaye Hebert
(cc: Enclosures)

SHRINERS HOSPITAL
SAN FRANCISCO
FOR CRIPPLED CHILDREN - [illegible] SAN FRANCISCO CA [illegible]

April 17, 1991

Shriners Hospital
Tampa Unit
Medical Record Division
12502 North Pine Drive
Tampa, Florida 33612-9499

To Whom It May Concern:

I am endorsing the study that Kristin Syms and Deborah Bolding are conducting through Shriners Hospital, San Francisco Unit. They are surveying parents of children with below elbow limb deficiencies, aged 7-18. Following the approval of Newton C. McCollough, III, M.D. I support the request for all of the medical record numbers of patients with below elbow limb deficiencies, aged 7-18 at each of the Shrine Units be sent to Kristin Syms.

Thank you for your attention to this matter.

Sincerely,

Stephen R. Skinner, M.D.
Chief of Staff
San Francisco Unit

SRS:dh

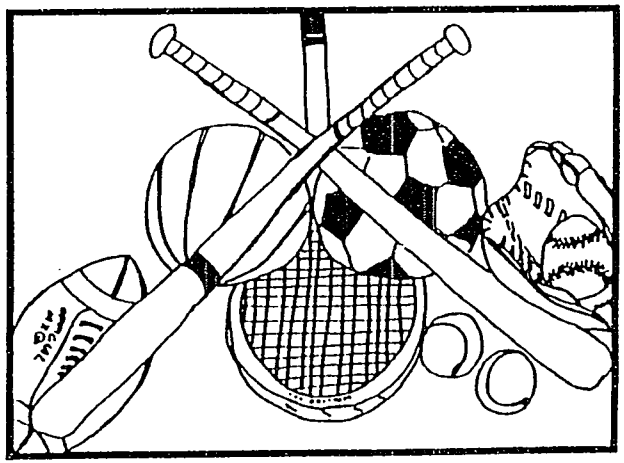
cc: Newton C. McCollough, III, M.D.
Kristin Syms, OTR

APPENDIX B

QUESTIONNAIRE

PARTICIPATION IN SPORTS
BY CHILDREN WITH A BELOW ELBOW LIMB DEFICIENCY
AND THEIR ABLE-BODIED PEERS
AGED SEVEN TO EIGHTEEN: A DESCRIPTIVE STUDY

This survey is being conducted to better understand participation in organized sports by children and teens with amputations. Please answer all the questions. If you wish to comment on any questions or qualify your answers, please feel free to use the space in the margins. Your comments will be read and taken into account. Thank you for your help.



These questions refer to organized sports leagues sponsored by your community, school, or church:

1. Does your child play sports in an organized sports league currently or have they played in the past?
(Circle one):
1. Yes
2. No

If you answered YES to this question, please answer the following questions below. If you answered NO, please go to question number 18.

2. Has your child ever been involved in any of these activities? If so, please circle the amount of time they have participated in the listed activities, and if they wear prosthesis when participating.

				wears prosthesis	
swimming	up to 1 year	2-3 years	3+ years	yes	no
t ball	up to 1 year	2-3 years	3+ years	yes	no
baseball	up to 1 year	2-3 years	3+ years	yes	no
soccer	up to 1 year	2-3 years	3+ years	yes	no
volleyball	up to 1 year	2-3 years	3+ years	yes	no
football	up to 1 year	2-3 years	3+ years	yes	no
basketball	up to 1 year	2-3 years	3+ years	yes	no
hockey	up to 1 year	2-3 years	3+ years	yes	no
tennis	up to 1 year	2-3 years	3+ years	yes	no
gymnastics	up to 1 year	2-3 years	3+ years	yes	no
dance	up to 1 year	2-3 years	3+ years	yes	no

3. Does your child pad his or her prosthesis when playing sports?
(Circle one):
1. Yes
2. No

4. Does your child use a special terminal device when he/she plays sports activities? (Circle one): If yes, what kind?
1. Yes Type: _____
2. No

5. Has your child ever broken or damaged a prosthesis while playing sports?
(Circle One):
1. Yes
2. No

If yes, in which sport have they damaged or broken the prosthesis? _____

6. Has your child ever received an injury that required a visit to a doctor while playing in a league or community sports? (Circle one):
1. Yes
2. No

If yes, in which sport did they receive an injury? _____

If you answered YES to this question, please answer the questions below. If you answered NO, please go to question number 13.

7. Where was the injury? (Check all that apply):

___Right arm
___Right leg
___Left arm
___Left leg
___Head
___Ribs
___Back/Spinal Cord
___Other. Please Describe: _____

8. Type of injury. (Check all that apply):

___Cut/scratch/abrasion
___Broken bone
___Concussion
___Sprain/strain
___Dislocation
___Other. Please describe: _____

9. Was your child hospitalized? (Circle one):
1. Yes
2. No

10. If yes, how many days?
_____ days

11. Did your child miss school as a result of the injury? (Circle one):
1. Yes
2. No

12. If yes, how many days?
_____ days

13. Has your child ever been responsible for injuring another child with his or her prosthesis while playing sports? (Circle one):
1. Yes
2. No

If yes, in which sport? _____

If you answered YES to this question, please answer the questions below. If you answered NO, please go to question 18.

14. Where was the injury? (Check all that apply):

___Right arm
___Right leg
___Left arm
___Left leg
___Head
___Ribs
___Back/Spinal cord
___Other. Please Describe: _____

Type of injury. (Check all that apply):
Cut/scratch/abrasion
Broken bone
Concussion
Sprain/strain
Dislocation
Other. Please describe:

15. Was the other child hospitalized? (Circle one).
    1. Yes
    2. No

16. If yes, how many days?
    _ _ days

17. In your opinion, was your child's prosthesis instrumental in causing the injury to the other child?
    1. Yes
    2. No

18. Your child's age: _ _ years

19. Your child's grade in school: _ _ grade

20. Your child's gender: (Circle one):
    1. Male
    2. Female

21. State of residence:

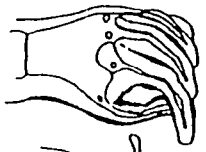
22. Parents' occupations:

Level of childs's amputation: (Circle one):
    1. Partial Hand
    2. Wrist Level
    3. Long Below Elbow
    4. Short below elbow
    5. Above Elbow
    6. Shoulder

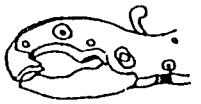
Does your child have a prosthesis that fits? (Circle one):
    1. Yes
    2. No

How often does your child wear the prosthesis? (Circle one):
    1. Most of the day (More than 10 hours)
    2. Part of the day (less than 10 hours)
    3. Several times a week
    4. A few times a month
    5. A few times per year
    6. Never

What type of terminal device does your child use?

1. Mechanical Hand 

2. Voluntary Opening Hook 

3. Voluntary Closing Hook 

4. Capp 

5. Sport Mitt 

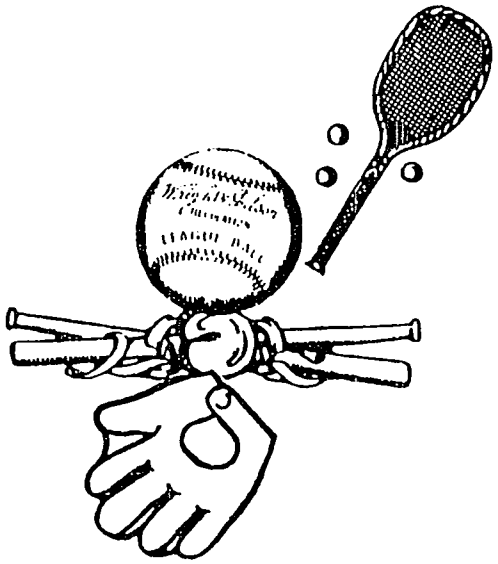
6. Cosmetic Hand 

7. Other. Please Describe _____

8. Not Applicable

Is there anything else you would like to tell us about?

If so, please use this space for that purpose . . .



Your contribution to this effort is very greatly appreciated. If you would like a summary of the results, please print your name and address on the back of the return envelope (NOT on this questionnaire). We will see that you get it.

APPENDIX C

COVER LETTER AND

CONSENT FORMS FROM PARENTS

SJSU SAN JOSE STATE UNIVERSITY

A campus of The California State University

School of Applied Arts and Sciences • *Department of Occupational Therapy*
One Washington Square • San José, California 95192-0059 • Main Office: 408/924-3070 • Fieldwork Office: 408/924-3078

Dear Parent:

I am conducting a study regarding participation of boys and girls aged 7 to 18 with a below elbow limb deficiency in organized contact sports, and the injuries that have occurred to themselves or others as a result of participation. The findings should help our understanding of safety and eligibility issues that participation in sports has for the child with a below elbow limb deficiency and their teammates.

You will find a copy of the survey and a consent form enclosed. Please return the survey and consent in the attached envelope. EVEN IF YOUR CHILD DOES NOT PARTICIPATE IN ORGANIZED SPORTS, PLEASE ANSWER THE APPLICABLE QUESTIONS AND RETURN THE SURVEY.

The study is being conducted through the Shriners Hospitals for Crippled Children, Children's Hospital at Stanford and other cooperating hospitals. If you have any questions about this study, I would be happy to talk with you. Please call Kristin Syms at (415) 726-9148.

Your participation in this study is voluntary. I appreciate your efforts in completing the survey.

Sincerely,

Kristin Syms

Kristin Syms
Graduate Student
Occupational Therapy Program

SJSU SAN JOSE STATE UNIVERSITY

A campus of The California State University

School of Applied Arts and Sciences • Department of Occupational Therapy
One Washington Square • San José, California 95192-0059 • Main Office: 408/924-3070 • Fieldwork Office: 408/924-3078

CONSENT FORM

AGREEMENT TO PARTICIPATE IN RESEARCH
SAN JOSE STATE UNIVERSITY

RESPONSIBLE INVESTIGATOR: Kristin Syms

TITLE OF PROTOCOL: Participation in sports by children with a below elbow limb deficiency and their able-bodied peers aged seven to eighteen: A comparison study.

I have been asked to participate in a research study that is investigating the participation rate of children with a below elbow limb deficiency in organized sports, and the subsequent rate of injuries that they may have sustained or inflicted upon others (because of their prosthesis) due to this participation. The results of this study should further our understanding of 1) the frequency children with a below elbow limb deficiency injure themselves or others when playing organized sports, 2) the degree and type of injuries that these children may have sustained, and 3) the wearing patterns of prostheses by children with a below elbow limb deficiency when playing sports.

I understand that

1) I will be asked to fill out one questionnaire which will take approximately 15 minutes, at either the designated hospital or in my home.

2) there are no anticipated risks expected.

3) the possible benefits of this study to me are that the information gathered will allow health professionals, school officials, and myself as a parent to better understand the safety issues that participation in sports has for a child with a below elbow limb deficiency or other children playing with a child wearing a prosthesis. Ultimately, this information will assist schools, health professionals, and parents in obtaining authorization so as to allow a child with a below elbow limb deficiency the opportunity to play sports, and to not be denied participation based on the safety issues of wearing a prosthesis during play.

4) the results from this study may be published, but any information from this study that can be identified with me will remain confidential and will be disclosed only with my permission.

5) any questions about my participation in this study will be answered by Kristin Syms (415) 726-9148. Complaints about the procedures may be presented to Dr. Lela Llorens, (408) 924-3070; Department Chair for Occupational Therapy. For questions or complaints about research subject's rights, or in the event or research-related injury, contact Serena Stanford, PhD. (Associate Academic Vice President for Graduate Studies & Research) at 924-2480.

6) my consent is given voluntarily without being coerced; I may refuse to participate in this study or in any part of this study, and I may withdraw at any time, without prejudice to my relations with SJSU, Children's Hospital at Stanford, Shriner's Crippled Children's Hospital, and Area Child's Amputee Center of Grand Rapids, Michigan.

7) I have received a copy of this consent form for my file.

I HAVE MADE A DECISION WHETHER OR NOT TO PARTICIPATE. MY SIGNATURE INDICATES THAT I HAVE READ THE INFORMATION PROVIDED ABOVE AND THAT I HAVE DECIDED TO PARTICIPATE.

_____ _____

DATE SUBJECT'S SIGNATURE

_____

INVESTIGATOR'S SIGNATURE