2003

Occurrence of wrist injury in collegiate baseball athletes by position

Kevin C. Robell
San Jose State University

Follow this and additional works at: https://scholarworks.sjsu.edu/etd_theses

Recommended Citation

Robell, Kevin C., "Occurrence of wrist injury in collegiate baseball athletes by position" (2003). *Master's Theses*. 2486.

DOI: <https://doi.org/10.31979/etd.9sja-64rr>

https://scholarworks.sjsu.edu/etd_theses/2486

This Thesis is brought to you for free and open access by the Master's Theses and Graduate Research at SJSU ScholarWorks. It has been accepted for inclusion in Master's Theses by an authorized administrator of SJSU ScholarWorks. For more information, please contact scholarworks@sjsu.edu.

Occurrence of Wrist Injury in Collegiate Baseball Athletes by Position

A Research Project

Presented to

The Faculty of the Department of Human Performance

San Jose State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Arts

By

Kevin C. Robell ATC, EMT

December 2003

UMI Number: 1418715

Copyright 2003 by
Robell, Kevin C.

All rights reserved.

INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

UMI Microform 1418715

Copyright 2004 by ProQuest Information and Learning Company.

All rights reserved. This microform edition is protected against
unauthorized copying under Title 17, United States Code.

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

© 2003

Kevin C. Robell

ALL RIGHTS RESERVED

APPROVED FOR THE DEPARTMENT OF HUMAN PERFORMANCE

Dr. Leamor Kahanov

Dr. Susan Wilkinson

Dr. Emily H. Wughalter

APPROVED BY THE UNIVERSITY

ABSTRACT

THE OCCURRENCE OF WRIST INJURY IN COLLEGIATE BASEBALL ATHLETES BY POSITION

by Kevin C. Robell

The purpose of this research was to analyze the occurrence of wrist injury in a sample of collegiate baseball players and its association to field position. Participants included male collegiate baseball position players, ages 18-23 years. One hundred and twenty-five baseball athletes were recruited from eight Bay-area colleges and universities including both 4-year and community college institutions of higher education. Upon consent, an interview questionnaire was used as the instrument to collect the data. This interview questionnaire was administered to each participant by the investigator during the stretching and warm-up portion of a practice session. Results indicate that, within this particular sample population, a considerable number of position players have sustained wrist injuries during their baseball career reinforcing the need for qualified health care professionals during games and practices. Results from this study also indicate that the majority of wrist injuries observed within this sample may occur from offensive activities.

ACKNOWLEDGEMENTS

I would like to dedicate this manuscript to my late mother Anita Rae, who, without her continual unconditional love and support during my early years this experience would not at all been possible. I want to send a special thank you to my entire family. It has been their encouragement that has kept this point in my life within reach. I would like to send a sincere thank you to my committee, Dr. Kahanov, Dr. Wilkinson, and Dr. Wughalter, for their help and guidance throughout the course of this experience. Thanks to each and every individual who contributed to the successful completion of this study. Finally, a special thank you to everyone who encouraged and pointed me in the right direction throughout the course of my graduate experience.

TABLE OF CONTENTS

	Page
List of Tables.....	ix
List of Figures.....	x
Journal Article – International Journal of Sports Medicine	
Article Submission.....	1
Cover Page.....	1
Abstract.....	2
Introduction.....	3
Methods.....	4
Participants.....	4
Instrumentation.....	4
Procedures.....	5
Analysis of Data.....	6
Results.....	6
Wrist Injury Information.....	7
Wrist Injury by Player Position.....	8
Discussion.....	9
Conclusion.....	14
References.....	16
Extended Support Material.....	27

CHAPTER 1 - Introduction

Purpose.....	33
Hypothesis.....	33
Limitations.....	33
Delimitations.....	33
Definition of Terms.....	34
Project Completion.....	36
Summary.....	37

CHAPTER 2 - Review of Literature

Anatomy of the Wrist.....	39
Bony Anatomy of the Wrist.....	39
Ligamentous Anatomy of the Wrist.....	42
Injuries to the Wrist.....	44
Mechanism of Injury to the Wrist.....	44
Fractures of the Wrist.....	46
Scaphoid Fractures.....	46
Hook of the Hamate Fracture.....	47
Ligamentous Injuries Occurring to the Wrist.....	48
Scapholunate Dissociation.....	48
Perilunar Dislocations.....	49
Triangulofibrocartilage Complex (TFCC) Injury.....	51
Incidence of Wrist Injury In Athletics.....	52

Summary.....	56
CHAPTER 3 – Methods	
Participants.....	59
Instrumentation.....	59
Procedures.....	62
Analysis of Data.....	63
Summary.....	63
Project Completion.....	66
REFERENCES.....	67
APPENDIX A. Authors notes for <i>International Journal of Sports Medicine</i>	70
APPENDIX B. Permission Letter.....	77
APPENDIX C. Occurrence of Baseball-Related Wrist Injury Interview Questionnaire..	79
APPENDIX D. Validation Letter.....	81
APPENDIX E. Anatomical Zones of The Wrist.....	83
APPENDIX F. Letter of Consent.....	85
APPENDIX G. Institutional Review Board Approval Letter.....	87

LIST OF TABLES

Table 1. Age, Year of Eligibility, and Primary Field Position of Baseball Players.....	17
Table 2. Cross Tabulation Table Between Injury Occurrence and Age of Collegiate Baseball Athletes.....	18
Table 3. Type of Field Activity During Which Wrist Injury was Sustained.....	19
Table 4. Injured Wrist Area Indicated by Baseball Athletes.....	20
Table 5. Initial Care of Wrist Injury by Sports Medicine Personnel.....	21
Table 6. Elapsed Time Between Injury and Medical Attention Sought by Baseball Athletes.....	22
Table 7. Wrist Injury Diagnosis.....	23
Table 8. The Occurrence of Wrist Injuries by Primary Field Position and Game or Practice Situations.....	24
Table 9. Wrist Injury Compared to Primary Field Position.....	25
Table 10. Specific Wrist Injury Compared to Field Activity.....	26

LIST OF FIGURES

Figure 1: Dorsal view of the wrist.....	40
Figure 2: Palmar view of the wrist.....	41
Figure 3: Ligaments of the wrist.....	43
Figure 4: Ulnar sided ligaments of the wrist.....	44

OCCURRENCE OF WRIST INJURY IN COLLEGIATE BASEBALL ATHLETES BY FIELD POSITION

By

Kevin C. Robell ATC, EMT
Assistant Athletic Trainer
Saint Mary's College
(925) 631-4398
krobell@stmarys-ca.edu

Occurrence of Wrist Injury in Collegiate Baseball Athletes by Position

Objective: The objective was to determine the impact of field position on the occurrence of wrist injury in a sample of collegiate baseball athletes.

Design and Setting: Data collection was accomplished through the use of an interview questionnaire administered by the investigator during the stretching/warm-up portion of an in-season practice session.

Subjects: One hundred and twenty-five position players from eight different Bay-area universities and community colleges participated in the investigation.

Measurements: Descriptive statistics were used for demographical information. Cross tabulations were used to assess associations between player field position and the occurrence of wrist injuries.

Results: Forty percent of baseball position players in this study sustained a wrist injury at some point in their baseball career, while 68% of these injuries occurred during a baseball game. The majority of these injured athletes were middle infielders (49%), and outfielders (33%). Fifty-four percent of injuries observed in this study occurred during their college baseball career. The majority of injured athletes recall being injured from sliding into a base (34%), or swinging a bat (24%). Seventy-eight percent of injuries were sustained in the ulnar aspect of the wrist, while 56% of injured athletes did not seek medical attention for at least a week. Twenty-two percent of injured athletes suffered a "sprain" or "strain", while 18% sustained some type of fracture. Twenty-one percent were forced to miss more than 21 days of participation. Half of injured first base players missed more than 21 days.

Conclusions: Results of this study indicate that, within this particular sample, a considerable number of collegiate position players are sustaining wrist injuries during their baseball career and reinforce the need for qualified health care professional during these events. In addition, results from this sample population indicate that more focus needs to be placed on the offensive activities than the actual defensive field position played.

Key Words: Defensive position, morbidity, bony injuries, ligamentous injuries, injury incidence.

Introduction

Research on the occurrence of wrist injury in the sport of baseball, particularly at the collegiate level, has been lacking in comparison to sports such as gymnastics and football. In the sport of football, players protect exposed parts of the body from potential blows. Awareness of the occurrence of wrist injury in a particular sport, such as baseball, is important for the sports medicine professional in order to provide the best possible care to an athlete who has sustained a wrist injury. The baseball athlete's wrist may endure similar high velocity contact forces, which can increase the incidence of wrist injury.¹ Thus appropriate evaluation and diagnosis may minimize time loss and long-term morbidity.

The limited amount of research on the incidence of wrist injury in baseball may hinder the sports medicine specialist in obtaining a proper diagnosis and optimal treatment. Due to the refinement in the diagnoses and treatment of athletic-related wrist injuries within the past decade, a better understanding of wrist kinematics, as well as specific tools, have been developed for the clinician to facilitate an accurate diagnosis and provide insight into the best possible method of treatment. However, without detailed information on baseball kinematics, injury by position, and activity during the time of injury, appropriate injury prevention cannot be accomplished.²

In 2002, the annual Injury Surveillance System (ISS) conducted by the National Collegiate Athletics Association (NCAA) stated a game wrist injury rate of .330 exists and a practice wrist injury rate of .050 exists in collegiate baseball.³ Two studies, the NCAA Injury Surveillance System³ and the National Athletic Trainers' Association

60 Injury Surveillance Study⁴ measured overall wrist injury incidence without any
61 distinction to activity or position played at the time of injury. According to the National
62 Athletic Trainers' Association ISS, approximately a quarter of all injuries in baseball
63 are to forearm, wrist, or hand (24%), with 23% of these injuries forcing the athlete to
64 miss at least seven days of participation, yet, research that elaborates on the incidence of
65 wrist injury, or injury rates, in the sport of baseball as it relates to position on the field is
66 lacking.⁴ Therefore the purpose of this research study was to investigate the impact of
67 field position on the occurrence of wrist injury in collegiate baseball athletes.

68 Methods

69 *Participants*

70 One hundred and twenty-five intercollegiate baseball athletes from eight Bay-area
71 universities and community colleges who have played one of the eight field positions,
72 excluding pitcher, volunteered to participate in the investigation. Baseball players acting
73 as the designated hitter were also included in the study sample. All players participate in
74 the act of hitting during the offensive portion of the contest and thus are included as
75 offensive players in addition to their defensive field position. Baseball programs were
76 chosen for inclusion in the study based on a representative sample from 8 of the 23-Bay
77 area universities and community colleges.

78 *Instrumentation*

79 Using previous research methods as a basis, an interview questionnaire was
80 constructed by the researcher and was used to collect wrist injury data from
81 participants.²⁻¹³ Modifications to the National Athletic Trainers' Association and NCAA

82 Injury Surveillance Systems for the current study included an expansion of the
83 categories of health care profession, as well as an augmentation of time loss injuries to
84 include those due to immobilization. In totality, the questionnaire was completed as an
85 amalgamation of past research on wrist injuries in order to obtain rich and detailed
86 information on collegiate baseball players' wrist injuries.

87 The "Occurrence of Baseball-Related Wrist Injury Interview Questionnaire"
88 (OBWI) contains 16 items divided into two sections: 1) demographic data (age, year of
89 eligibility, and primary field position), and 2) 13 questions designed to establish the
90 occurrence and nature of wrist injury sustained at some point in the participants baseball
91 career.

92 A 9-person panel of experts in the field of health care reviewed the questionnaire
93 for validity. Review of the interview questionnaire identified additional items that
94 needed to be included to produce comprehensive data. Sequential ordering of the items
95 was also suggested to allow smooth administration of the interview questionnaire. The
96 questionnaire was modified accordingly.

97 *Procedures*

98 Prior to testing, the Athletic Director or Associate Athletic Director from each of
99 the 8 participating institutions granted the investigator permission to conduct research
100 on the collegiate baseball athletes at their institution. Approval to conduct the interview
101 research was granted by the Institutional Review Board of Human Subjects at San Jose
102 State University. On the day of testing, the investigator administered the OBWI to each
103 participant. Each participant was informed that consent is implied upon completion of

104 the interview questionnaire. The OBWI was administered during the stretching and
105 warm-up portion of an in-season practice session, allowing minimal practice disruption
106 while providing an environment for one on one conversation. In cases where an athlete
107 had not sustained a wrist injury, only demographic data was collected. Questionnaires
108 were administered for each injury in cases where a participant had suffered multiple
109 wrist injuries. Questionnaires were then compiled with the same institution
110 identification code for analysis. Data collection was completed when each position
111 player on the current roster, present on the day of testing, completed the interview
112 questionnaire.

113 *Analysis of Data*

114 Demographic data were analyzed using descriptive statistics including: mean,
115 range, standard deviation and percentages. In addition, a cross tabulation, and η^2
116 analysis were conducted to assess the association between field position and the
117 occurrence of wrist injury since the assumptions of Chi Squared were violated. SPSS
118 (SPSS 2003, version 11.0) was used to calculate and analyze the data.

119 *Results*

120 One hundred and twenty-five (100%) intercollegiate baseball athletes participated
121 in the study. The average age of participants was 20 years, 1 month and 6 days (1yr, 3
122 months SD) (Table 1). Sixty-five percent (n=81) of the participants were under the age
123 of 21. Seventy-two percent (n=91) of the sample had an eligibility status of freshman or
124 sophomore (Table 1). The majority of the sample was classified as outfielders or middle

125 infielders, 36% and 26% respectively, while one fifth were catchers, with the remainder
126 of the players being first and third base players (Table 1).

127 *Wrist Injury Information*

128 Fifty of the 125 participants (40%) recalled sustaining a wrist injury at some point
129 in their baseball career (Table 2). Fifty-four percent of the injured population reported
130 injuries during college and the majority of injuries were found to have occurred within
131 approximately two years ($n=22$). From the 50 participants that sustained a wrist injury
132 during their baseball career, 68% occurred during a game while 32% occurred during
133 practice.

134 Within the injured population, the majority of participants recalled the injury to be
135 a result of either sliding into a base (34%), swinging a bat (24%), impact with the ball
136 (18%), or diving for a ball (22%)(Table 3). Head-first (18%) and feet-first (16%) sliding
137 revealed similar results. Seventy-eight percent of wrist injuries occurred to the ulnar
138 aspect of the wrist, with the central and ulnar dorsal zones each contributing to a quarter
139 of the injured area (Table 4). The ulnar volar zone accounted for a third of the injuries.

140 The majority of athletes (62%) sought medical attention through a certified athletic
141 trainer (Table 5). Over half of injured athletes (56%) did not seek medical attention for
142 at least a week following the injury (Table 6). Of the athletes who recalled the type of
143 wrist injury sustained, 44% sustained a "sprain" or a "strain", while 18% suffered some
144 form of fracture to the wrist (Table 7).

145 After sustaining a wrist injury, 76% of injured baseball athletes continued to
146 practice or play during that session. Although the majority of time lost due to injury was

147 0 to 7 days (72%), 22% of injured baseball athletes were forced to miss more than 21
148 days of participation (Table 6). Seventy percent of wrist injuries in this study were
149 immobilized for a maximum of 1 week and 2 days. The most popular form of
150 intervention for a wrist injury was identified as rehabilitative taping. Twenty-four
151 percent of injured athletes taped their wrist for a lengthy period of time following the
152 injury, while 40% of injured athletes did not have any intervention.

153 *Wrist Injury by Player Position*

154 Primary field position and the occurrence of wrist injury were cross-tabulated and
155 indicated that the majority of injured baseball athletes were middle infielders and
156 outfielders, accounting for 49% and 33% of the injured population respectively (Table
157 8). First and third base players together accounted for only 10.5% of the injured
158 population. Injured athletes indicated by pointing to their wrist that injuries occurred to
159 the ulnar aspect of the wrist in 87% of outfielders, 88% of middle infielders, 63% of
160 catchers, and 71% of first base players.

161 In table 9 the types of injuries that the baseball players recalled as a diagnosis are
162 illustrated. Seventy-two percent of injured baseball athletes recalled the nature of the
163 injury sustained. Of the 12 injured middle infielders and nine of the injured outfielders,
164 10 (48%) suffered a "sprain" or "strain" (Table 9). Three of the five injured first base
165 players (60%), and all six of the injured catchers that had recalled the type of injury,
166 recalled sustaining a "sprain" or "strain".

167 After sustaining a wrist injury, while the majority of outfielders, catchers, and
168 middle infielders missed 0-7 days of participation, over half of first base players missed

169 more than 21 days of participation. Of the 40% of injured position players that needed
170 some form of intervention (e.g. surgery, cast, brace, splint, or tape), approximately half
171 of the injured baseball athletes (outfielders, middle infielders, and catchers) used some
172 form of protection after sustaining the injury. While one first base player used a brace
173 following the injury, 40% of these position players did not use or require any
174 intervention.

Seventy-six percent of injured baseball athletes continued to practice or play during the current session. The majority of the injured position players that continued to practice or play were outfielders (86.7%), catchers (87.5%), and middle infielders (75%). Only three injured first base players continued to practice or play during the current session.

Discussion

181 The purpose of this research investigation was to add to the limited research on the
182 impact of field position on the occurrence of wrist injury in collegiate baseball athletes.
183 The fact that the majority of participants in this study had an eligibility status of
184 freshman or sophomore may be due to the fact that half of the institutions included in
185 this study were 2-year institutions of higher education. Thus the athletes allowed to
186 compete would be in this status. The majority of injured position players were injured
187 within a year and a half of testing, perhaps illustrating, and could be defined as
188 relatively recent and most likely recalled with some accuracy as to the nature, time, and
189 type of injury.

190 Results from this study indicate that, within this sample population, a considerable
191 number of collegiate baseball players have sustained at least one form of wrist injury at
192 some point in their baseball career (Table 2). The majority of injured athletes were
193 infielders, and outfielders. Among infielders and outfielders, the data suggest that the
194 majority of these athletes sustained injuries during games. These data oppose similar
195 research in other sports such as football where the majority of injuries occur during
196 practice.³ This comparison on injury occurrence between these two sports may be due
197 to the fact that baseball inherently has several more games a week than many other
198 sports, such as football. The increase in baseball wrist injuries during games may
199 reinforce the necessity of the presence of a health care professional during competition.

200 Eighty percent of injured position players in this study sustained a wrist injury
201 during activities that were irrelevant to defensive field position such as sliding into a
202 base, swinging a bat, or impact with the ball (Table 3). All of these tasks occur during
203 the offensive portion of a practice or contest. In addition, 20% of these injured athletes
204 recall sustaining some form of fracture as a result of offensive-related tasks (Table 10).
205 These results may necessitate the need for coaches and sports medicine personnel to pay
206 more attention to offensive mechanisms of injury for prevention and for diagnostic
207 purposes. However, results on sliding indicate that the type of slide (feet first or head
208 first) is irrelevant, both contributing to the same number of wrist injuries. Therefore,
209 instruction on sliding should probably not entail a proclivity for the direction of the
210 slide.

211 Plancher and Minnich¹ postulated that compressive forces of the knob of a bat,
212 racquet, or club, may predispose the athlete to fractures to the hook of the hamate,
213 contributing to the offensive wrist injuries. Historically, the biographies of these field
214 positions at the collegiate level reveal stronger, bigger, powerful hitters, and a less agile
215 athlete than that of the two middle infield positions or the three outfield positions which
216 may contribute to a longer swing that generates power and may predispose the athlete to
217 injury.¹ The long swing allows the knob of the bat to contact the wrist directly in the
218 ulnar fossa indicating that something unique exists swinging a bat that may predispose
219 the field position player to hook of the hamate fracture.¹ Furthermore, investigation into
220 the type of bat used may provide helpful information, but was not investigated in the
221 current study. Bat type is an important issue given the current use of aluminum bats at
222 the college level which have been scrutinized for their capability of producing abnormal
223 ball rebound velocities and bat speed, yet there is no research currently on the type of
224 aluminum bat and occurrence of wrist injury in collegiate baseball, nor is there any
225 available research on the specifications of handle or knob measurements in collegiate
226 baseball.¹⁴ Sports medicine personnel should cautiously include these types of inquiries
227 into bat type, athlete's size, and type of swing, when providing consultation on
228 prevention, evaluation, and rehabilitation of the injured athlete upon return to activity.

229 Following a wrist injury, 76% of injured position players continued to practice or
230 play during the session in which they were injured. The majority of this sample
231 included outfielders, middle infielders, and catchers. However, 57% of first base players
232 did not continue to practice or play during the session that they were injured which may

233 be due to the nature of injury sustained. Forty percent of injuries suffered by these
234 players were in the form of a fracture, which is directly related to the fact that 57% of
235 injured first base players missed more than 21 days of participation (Table 6). This may
236 be because these wrist injuries are not allowing the first base players the capability to
237 play this position, or swing a bat effectively, forcing them to be refrained from
238 competition for an extended period of time to allow for proper healing. Traditionally,
239 these players are bigger and stronger than the other positions on the field. In addition,
240 swing biomechanics of these athletes may produce more power than other swings, but
241 has not been previously explored in the research. Unfortunately, this type of swing may
242 predispose this baseball athlete to moderate or severe wrist injuries that may cause them
243 to miss extended amounts of competition, or worse, incur future disability.^{1,7}

244 Outside of the first base players, the majority of injured position players missed as
245 much as a week of participation. Coupled with the fact that the majority of these
246 athletes did not seek medical attention for at least a week, these athletes may continue to
247 participate with these injuries. These athletes may feel that they can play their position
248 effectively after suffering a wrist injury, which can add to time loss due to overuse or
249 mismanagement.

250 A typical regular season in collegiate baseball runs from mid January to late April.
251 Wrist injured athletes may miss close to a quarter of the season based on the average
252 time loss, which may contribute to the decision not to seek medical attention and to
253 continue play. The majority of the documented research on the management of athletic
254 related wrist injuries involve the wrist to be immobilized for a minimum of 3 weeks and

255 as long as 13 weeks.^{7, 11, 12} Proper rehabilitation has been reported to last an additional
256 3-6 weeks.^{7, 12} Therefore it is imperative that sports medicine personnel are aware of the
257 possible wrist injury outcomes, and the decisions that an athlete may decide to make in
258 an attempt to "keep playing" in order to reduce the risk of time loss and possible
259 sequelae following a wrist injury.

260 Severe wrist injury often occurs due to specific mechanisms.^{1, 15, 16} Halikis and
261 Taleisnik² described the mechanism of wrist injury as either a single episode or
262 repetitive stresses. In addition, wrist injuries are often sustained in extension.¹⁰ Wrist
263 extension injury-mechanisms are seen frequently through different tasks in baseball
264 such as swinging a bat, sliding into a base, or catching a ball against a wall or onto the
265 ground. These mechanisms and the potential injurious outcomes, place an increased
266 need on the presence of sport medicine personnel at these games. Not only is the
267 presence of a sports medicine professional necessary at these events, the sports
268 medicine professional responsible for these types of athletes has a responsibility to be
269 informed of specific injurious mechanisms in the sport of baseball in order to provide
270 the wrist injured athlete timely intervention, proper treatment, as well as specific
271 prevention strategies that will allow a healthy and efficient recovery and return to
272 competition.

273 The results of the current study suggest that injured baseball athletes within this
274 sample, although the majority of injuries dismissed by the athlete as a "sprain" or
275 "strain," are not typically seeking medical attention (Table 6). Instead they continue to
276 play with little or no protection. This raises the question as to the actual severity of the

277 injury. Is the injury that these athletes have sustained actually a “sprain” or a “strain”, or
278 are the athletes simply playing with pain in order not to miss competition with long-
279 term effects? A longitudinal study may uncover information on wrist injuries that are
280 not reported to medical personnel and illustrate a better understanding of the type of
281 injuries sustained on the field.

282 Part of the responsibility of most health care professionals is the recognition and
283 evaluation of athletic related injuries. Results from this study indicate that the position
284 played defensively is not as important for the type, severity, or time loss due to injury to
285 the baseball player as the offensive role. Thus a better understanding of the type of wrist
286 injuries, position played, and activity, would aid health care professionals in providing
287 proper medical care.

288 Conclusion

289 Results of this study indicate, within this representative sample, a considerable
290 number of collegiate position players are sustaining wrist injuries during their baseball
291 career and reinforce the need for a qualified health care professional, skilled in
292 evaluation, assessment, and management of athletic related injuries be present during
293 these events. These results allow important questions to be asked toward the
294 understanding of wrist injuries among baseball players, such as, what aspects about
295 swinging a bat predisposes the baseball athlete to wrist fractures, and, how many wrist
296 injuries go unreported during the course of a season? Clearly more research is needed
297 on the specific factors that may play a role in the ultimate fashion in which wrist
298 injuries are managed, as well as longitudinal studies as to the incidence and type of

299 unreported wrist injuries. Due to individual characteristics of each make of aluminum
300 bat, which type of bat provides the highest predisposition to wrist injury? In addition,
301 more research is needed on the characteristics and manufacturing of the handle, or
302 knob, of aluminum baseball bats used in collegiate baseball, and the association
303 between swing biomechanics and field position.

304

REFERENCES

- 304 1. Plancher KD, Minnich JM. Sports-specific injuries. *Clinics in Sports Medicine*
 305 1996;15:2:207-218.
- 306 2. Halikis MN, Taleisnik J. Soft-tissue injuries to the wrist. *Clinics of Sports*
 307 *Medicine* 1996;15:2:235-258.
- 308 3. National Collegiate Athletic Association. NCAA Injury Surveillance System
 309 Study 2002.
- 310 4. National Athletic Trainers Association. NATA Injury Surveillance Study 1995.
- 311 5. Mooney JF, Seigel, DB, Koman AL. Ligament injuries of the wrist in athletes.
 312 *Clinics in Sports Medicine* 1992;11:1:129-139.
- 313 6. Honing EW. Wrist injuries. Part 2: spotting and treating troublemakers. *The*
 314 *Physician and Sports Medicine* 1998;26:10:62.
- 315 7. Atkinson LS, Baxley EG. Scapholunate dissociation. *American Family*
 316 *Physician* 1994;49:8:1845-1851.
- 317 8. Boulas HJ, Milek MA. Gymnastic wrist injuries. *Orthopedic Reviews*
 318 1990;19:6:518-529.
- 319 9. Howse C. Wrist injuries in sport. *Journal of Sports Medicine* 1994;17:3:163-
 320 175.
- 321 10. Mayfield JK, Johnson RP, Kilcoyne RK. Carpal dislocations: pathomechanics
 322 and progressive perilunar instability. *American Journal of Hand Surgery*
 323 1980;5:3:226-241.
- 324 11. Morgan RL, Linder MM. Common wrist injuries. *American Family Physician*
 325 1997;55:3:857-869.
- 326 12. Raab DJ, Fisher DA, Quick DC. Lunate and perilunate dislocations in
 327 professional football players: a five-year retrospective analysis. *American*
 328 *Journal of Sports Medicine* 1994;22:6:84-89.
- 329 13. Rettig AC, Patel DV. Epidemiology of elbow, forearm, and wrist injuries in the
 330 athlete. *Clinics in Sports Medicine* 1995;14:2:289-297.
- 331 14. Crisco JJ, Greenwald RM, Blume JD, Penna LH. Batting performance of wood
 332 and metal baseball bats. *Medicine & Science in Sports And Exercise*
 333 2002;34:10:1675-1684.
- 334 15. Dobyns JH, Linscheid RL, Chao EYS. Traumatic instability of the wrist. In:
 335 *AAOS Instructional Lectures*. St.Louis, MI: CV Mosby, 1975:182-199.
- 336 16. Linscheid RL, Dobyns JH. Athletic injuries of the wrist. *Clinical Orthopaedics*
 337 1985;198:141-151.
- 338
- 339
- 340

340 Table 1. Age, Year of Eligibility, and Primary Field Position of Baseball Players
 341 (N=125).
 342

	Frequency (n)	Percent (%)
Age (in years)		
18	14	11.2%
19	36	28.8%
20	31	25.8%
21	17	13.6%
22	22	17.6%
23	5	4.0%
Total	125	100.0%
Year of Eligibility		
Freshman	62	49.6%
Sophomore	29	23.2%
Junior	22	17.6%
Senior	12	9.6%
Total	125	100.0%
True Status	70	56.0%
Medical Redshirt	7	5.6%
Redshirt	20	16.0%
Transfer	28	22.4%
Total	125	100.0%
Field Position		
Outfield	45	36.0%
Middle Infield	33	26.4%
Catcher	22	17.6%
First Base	12	9.6%
Third Base	13	10.4%
Total	125	100%

343

344

344 Table 2. Cross Tabulation Table between Injury Occurrence and Age of Collegiate
 345 Baseball Players (N=125).
 346
 347

	Age (in years)	Count	Percent w/in
Yes	18	5	10.0%
	19	14	28.0%
	20	17	34.0%
	21	5	10.0%
	22	8	16.0%
	23	1	2.0%
	Total	50	100.0%
No	18	9	12.0%
	19	22	29.3%
	20	14	18.7%
	21	12	16.0%
	22	14	18.7%
	23	4	5.3%
	Total	75	100.0%

348

349

349 Table 3. Type of Field Activity during Which Wrist Injury was Sustained (N=50).

Type of Field Activity	Frequency	Percent
Sliding	17	34.0%
Swinging a bat	12	24.0%
Impact w/ Player	1	2.0%
Impact w/ Ball	9	18.0%
Diving For Ball	11	22.0%
Other	0	0.0%
Total	50	100.0%

350

351

351 Table 4. Injured Wrist Area Indicated by Baseball Athletes (N=50).

Anatomical Area	Frequency	Percent
Radial Dorsal Zone	5	10.0
Central Dorsal Zone	13	26.0
Ulnar Dorsal Zone	13	26.0
Ulnar Volar Zone	15	30.0
Radial Volar Zone	4	8.0
Total	50	100.0

352

353

353 Table 5. Initial Care of Wrist Injury by Sports Medicine Personnel (N=50).

Sports Medicine Personnel	Frequency	Percent
ATC	31	62.0
Physician	7	14.0
Nurse	1	2.0
EMT	1	2.0
Parent	2	4.0
Other	8	16.0
Total	50	100.0

354

355

355 Table 6. Elapsed Time between Injury and Medical Attention Sought by Baseball
 356 Athletes (N=50).

Time until Medical attention	Frequency	Percent
Immediately	12	24.0
Within 24 Hrs	10	20.0
Within 1 st Week	12	24.0
Within 1 st Month	5	10.0
>1 Month	1	2.0
Never	10	20.0
Total	50	100.0

357

358

358 Table 7. Wrist Injury Diagnosis (N=50).

Type of Injury	Frequency	Percent
Sprain/Strain	22	44.0
Contusion	3	6.0
TFCC Tear	1	2.0
Torn Ligament	1	2.0
Hamate Fx	3	6.0
Pisiform Fx	1	2.0
Tendinitis	1	2.0
Fracture	4	8.0
Total	50	100.0

359

360

360 Table 8. The Occurrence of Wrist Injuries by Primary Field Position and Game or
 361 Practice Situations (N=50).
 362

		Occurrence of Injury		Injury Setting	
		Yes	No	Practice	Game
Field Position					
Outfield		15	30	4	11
	% w/in Field Position	33.3	66.7	26.7	73.3
Middle Infield		16	17	9	7
	% w/in Field Position	48.5	51.5	56.3	43.8
Catcher		8	14	1	7
	% w/in Field Position	36.4	63.6	12.5	87.5
First Base		7	5	1	6
	% w/in Field Position	58.3	41.7	12.3	85.7
Third Base		4	9	--	4
	% w/in Field Position	30.8	69.2	--	100.0
Total		50	75	15	35
	% w/in Field Position	40.0	60.0	30.0	70.0

363

364

364 Table 9. Wrist Injury Compared to Primary Field Position (N=50).

Field Position		Field Activity							Total
		Spr/ Sprain	Cont	TFCC Tear	Lig. Tear	Hamate Fx	Pisiform Fx	Tendinitis	
Outfield		5	1	--	--	--	--	1	2
	% w/in Field Position	55.6	11.1	--	--	--	--	11.1	22.2
Middle Infield		5	2	1	1	1	1	--	1
	% w/in Field Position	41.7	16.7	8.3	8.3	8.3	8.3	--	8.3
Catcher		6	--	--	--	--	--	--	--
	% w/in Field Position	100.0	--	--	--	--	--	--	--
First Base		3	--	--	--	1	--	--	1
	% w/in Field Position	60.0	--	--	--	20.0	--	--	20.0
Third Base		3	--	--	--	1	--	--	--
	% w/in Field Position	75.0	--	--	--	25.0	--	--	--
Total		22	3	1	1	3	1	1	4
	% w/in Field Position	61.1	8.3	2.8	2.8	8.3	2.8	2.8	11.1

365

366

366 Table 10. Specific Wrist Injury Compared by Field Activity (N=50).

		Field Activity					Total
Specific Injury		Sliding	Swinging a bat	Imp w/ ball	Diving for ball	Other*	
Spr/Strain		7	5	1	1	8	22
	% w/in Activity	31.8	22.7	4.5	4.5	36.4	100%
Contusion		--	--	--	3	--	3
	% w/in Activity	--	--	--	100.0	--	100%
TFCC Tear		1	--	--	--	--	1
	% w/in Activity	100.0	--	--	--	--	100%
Torn Ligament		--	1	--	--	--	1
	% w/in Activity	--	100.0	--	--	--	100%
Hamate Fx		--	3	--	--	--	3
	% w/in Activity	--	100.0	--	--	--	100%
Pisiform Fx		--	--	--	1	--	1
	% w/in Activity	--	--	--	100.0	--	100%
Tendinitis		--	1	--	--	--	1
	% w/in Activity	--	100.0	--	--	--	100%
Fracture		1	--	--	2	1	4
	% w/in Activity	25.0	--	--	50.0	25.0	100%
Total		9	10	1	7	9	36
	% w/in Activity	25.0	27.8	2.8	19.4	25.0	100%

367 * Other = Impact with player & Impact with wall

EXTENDED SUPPORT MATERIAL

CHAPTER 1

Introduction

Until 1980, wrist injuries other than fractures were not evaluated, and treatments to those injuries were often experimental (Halikis & Taleisnik, 1996). The lack of medical attention to the wrist may have stemmed from its complexity or that it is one of the least understood joints in the body (Mooney, Seigel, & Koman, 1992). As a result, an athlete who sustains a wrist injury has the potential to miss numerous days of competition, or worse, incur future disability. In the past, unless an obvious fracture was observed a specific diagnosis for active treatment was unavailable to the athlete (Halikis & Taleisnik, 1996). Instead, clinicians would dismiss the injury with the vague diagnosis of a “sprain” or “strain” (Honing, 1998; Mooney et al., 1992).

The absence of an identity given to various wrist injuries sustained by an athlete presents a problem for proper medical treatment. A surveillance study of 110 high school baseball teams conducted by the National Athletic Trainers’ Association (NATA) in 1995 revealed that 24% of injuries occurred to the forearm, wrist, and hand. Furthermore, 17% of those injuries were classified as sprains and 23% of these injuries prevented the athlete from participating for at least seven days (NATA, 1995). Consequently, a missed or vague diagnosis of a possible wrist injury can result in the failure of an athlete to return to competition. Therefore, proper assessment and treatment is necessary when confronted with a wrist-injured athlete.

Relatively recently a refinement in the diagnosis and treatment of athletic-related wrist injuries has occurred through clinical research, improved medical training, and

advances in diagnostic technology (Halikis et al., 1996). Athletic-related wrist injuries are less vague, allowing for a specific diagnosis and proper treatment plan to be prescribed. However, with the rapid increase in athletic participation over the last decade (Plancher & Minnich, 1996), together with the ever-growing competitive nature of sports, a greater demand has been placed on the sports medicine team to have a complex understanding of wrist injuries. Team physicians and certified athletic trainers must be able to recognize the potential injury risks inherent to a particular sport, provide an appropriate evaluation, and treat the wrist-injured athlete toward a swift recovery and safe return to competition. In order to properly assess injuries and have a working knowledge of injury risk in sports as they relate to a specific sport, position, and the biomechanics associated with different sports a, review of wrist injury incidences should be conducted.

Currently there is only one annual Injury Surveillance System (ISS), conducted by the National Collegiate Athletic Association (NCAA), investigating injury incidence at the collegiate level. The Injury Surveillance System was developed in 1982 to provide current and reliable data on injury trends in intercollegiate athletics (NCAA, 2002). Injury data are collected yearly from a representative sample of NCAA member institutions and the resulting data summaries are then reviewed by the NCAA Committee on Competitive Safeguards and Medical Aspects in Sports. Based on this injury data, the Injury Surveillance System has attempted to reduce injury rates through suggested changes in rules, protective equipment, or coaching techniques. Although the NCAA Injury Surveillance System reports on injury trends in the collegiate baseball athlete, it does not go into detail on which type of field position may be at a higher risk of wrist

injury. The purpose of this study was to investigate the association of field position on the occurrence of wrist injury in collegiate baseball athletes.

The lack of quantity and depth of research on the incidence of wrist injury in baseball poses a difficult task for certified athletic trainers and team physicians so that a thorough evaluation and correct method of treatment can be made. Due to the refinement in the diagnoses and treatment of athletic-related wrist injuries (Halikis et al., 1996) specific tools have been developed for clinicians to facilitate an accurate diagnosis and provide insight into the best possible method of treatment. Within the scope of sports medicine it is no longer acceptable to label an injured wrist as a "sprain" or a "strain" when the diagnosis is elusive (Honing, 1998; Mooney et al., 1992). Awareness of the occurrence of wrist injury in a particular sport, in this case baseball, is important for the sports medicine professional to understand in order to provide the best possible care to an athlete who has sustained a wrist injury which ultimately may minimize time loss and long term morbidity.

The quantity and depth of research on the occurrence of wrist injury in the sport of baseball, particularly at the collegiate level, has been lacking when compared to sports such as gymnastics and football. In the sport of football, players shield practically every exposed part of the body with some form of protection. The wrist, however, may be neglected from this protection from the same high velocity contact forces and tackling seen in this sport, thus increasing the incidence of wrist injury (Plancher et al., 1996). Baseball athletes may endure similar contact forces to the wrist, creating an environment that may predispose this athlete to wrist injury. In 1995, the Injury Surveillance Study

conducted by the National Athletic Trainers' Association identified that approximately 39% of high school varsity football athletes were injured during the 1995 season. The authors continued to state that of that 39%, 15% of injuries occurred to the forearm, wrist, or hand. This was second to the hip, thigh, or leg (17%). The majority of injuries sustained were minor (80%), while 11% were moderate and 9% were considered major. The occurrence of wrist injury in gymnastics derives itself from the fact that the upper extremities are used as a weight bearing limb acting in a closed kinetic chain (Gabel, 1998). Consequently, for both football and gymnastics, high impact loads are transmitted through the wrist joint, predisposing the athlete to different injury- mechanisms.

In 2002, the annual Injury Surveillance System conducted by the NCAA revealed that, although football had 72% more exposures, there was comparable practice and game wrist injury rates (.04, .43) compared to collegiate baseball (.05, .43) respectively (NCAA, 2002). Furthermore, although the Injury Surveillance System conducted by the NCAA did measure wrist injury incidence in the collegiate athlete, and, aside from the National Athletic Trainers' Association high school surveillance study in 1995, there is no research that has elaborated on the incidence of wrist injury, or injury rates, in the sport of baseball as it relates to position on the field. Therefore the purpose of this research study was to investigate the impact of field position on the occurrence of wrist injury in collegiate baseball athletes.

Halikis and Taleisnik (1996) described the mechanism of wrist injury as either a single episode or repetitive stresses. In addition, injury to the wrist was sustained while the wrist was in some form of extension. Mayfield, Johnson, and Kilcoyne (1980)

discovered that ulnar deviation and forearm supination, matched with extension, produced a scapholunate dissociation. Plancher and Minnich (1996) described that, as the hitter advances through contact of the ball during the act of swinging a bat, if the centrifugal force of the moving knob overcomes the hitters' grip on the bat, the compression impact can cause a fracture to the hamate bone. These mechanisms of injury are seen on a regular basis in the sport of baseball. Every time a player swings a bat, attempts to slide into a base, or makes a catch against a wall, there is the capacity of one or more of these pathomechanics to occur. The presence of these pathomechanics may predispose the collegiate baseball player to serious wrist injury. In addition, base stealers traditionally have been the fastest runners and have played one of the three outfield positions or a middle infield position. Furthermore, the bigger, stronger, power-hitter, traditionally plays either first base or third base. This information allows questions to be formed in this investigation. How often do players that swing a bat suffer a wrist injury? Which field position is at the highest risk of a wrist injury? How often does wrist injury occur when a player slides into a base? Why do players put on wrist splints once they reach base? These questions have not been previously explored. The answers to these questions may provide members of the sports medicine team with valuable information toward the evaluation and management of wrist injuries sustained in the sport of baseball. The referenced literature used in this study was adopted through a comprehensive peer-reviewed literature review of popular research databases.

Purpose

The purpose of this study was to investigate the occurrence of wrist injury in collegiate baseball athletes and its association on field position.

Hypothesis

The following null hypothesis was constructed for the purpose of this study:

1. There will not be any association of field position on the occurrence of wrist injury in collegiate baseball athletes.

Limitations

This study was limited to:

1. College-aged males who have been recruited to be a part of the baseball program at any of the eight participating San Francisco Bay area institutions.
2. All data collected in this study are based on participants' recall and is limited to participant responses and memory.

Delimitations

This study was delimited to:

1. Athletes who are current members of the baseball program at any of the eight San Francisco Bay area institutions.
2. 125 collegiate baseball athletes were used as participants in this research study. Only demographic information was collected in cases where participants had never sustained a wrist injury.
3. Position players at any of the eight participating Bay area institutions were included as participants in this study. Due to the fact that college baseball uses the designated

hitter rule, pitchers are not exposed to mechanisms of wrist injury during the act of pitching, and therefore were not included in the analysis.

Definition of Terms

Certified Athletic Trainer. A certified athletic trainer (ATC) is a health care professional who has been educated in the evaluation, treatment, and rehabilitation of athletic injuries, as established by the Role Delineation Study of the National Athletic Trainers' Association Board of Certification, Inc. (Starkey & Ryan, 1996).

Distal Radioulnar Joint. The distal radioulnar joint is formed by the distal head of the ulna and the ulnar notch of the radius (Starkey & Ryan, 1996).

Field Position Player. A baseball athlete that occupies one of the eight field positions on the diamond. For the purpose of this study, the three outfield positions (left, center, and right) were grouped together as outfielders. Both shortstop and second base players were grouped as middle infielders, and the remaining field positions, catchers, first base players, and third base players were grouped separately according to position. It is also assumed that, during the offensive portion of the contest, each of the nine field position players also partake in the act of hitting.

Fracture. Starkey and Ryan (1994) define a fracture as a disruption in the integrity of a bone. For the purposes of this study, fractures included disruption to any of the eight carpal bones, distal radius, or ulna.

Intercarpal Joint. The intercarpal joint contains the palmar, dorsal, and interosseus ligaments that fixate one carpal bone to its contiguous carpal bone in the same row

(Starkey & Ryan, 1996). For the purpose of this study, the intercarpal joints were limited to scapholunate and lunotriquetral joints.

Major Injury. A major injury is defined as an injury to the wrist that forces the athlete to miss more than 21 days of participation (NATA, 1995)

Mechanism of Injury. A mechanism of injury is defined as any physical or biological process in which injury or illness is produced (Starkey and Ryan, 1996). For the purpose of this study, the mechanism of injury included external forces acting on an extended, rotated, or deviated wrist; or swinging a bat.

Minor Injury. A minor injury is defined as an injury to the wrist that allows the athlete to return to participation within eight days (NATA, 1995).

Moderate Injury. A moderate injury is defined as an injury to the wrist that forces the athlete to miss between 8 and 21 days of participation (NATA, 1995).

Primary Field Position. The nine positions that a baseball team takes to defend the opposition. For the purpose of this study, primary field position was defined as the position that the participant was expected to start the 2003 season. In the case that the participant played multiple positions, primary field position is defined as the position where the athlete felt he played the majority of the time.

Physical Therapist. A physical therapist is a health care professional that is licensed to assist in the examination and rehabilitation of physically disabled or handicapped people. A physical therapist is qualified through a bachelor's or master's degree in physical therapy (Anderson, 1994).

Physician. A physician is a health care professional who has earned a degree of Doctor of Medicine (M.D.) after completing an approved course of study at an approved medical school (Anderson, 1994).

Radiocarpal Joint. The radiocarpal joint is formed by the articulation of the distal end of the radius with the scaphoid and lunate bones of the wrist (Starkey & Ryan, 1996).

Sports Medicine Professionals. A sports medicine professional describes an individual who has obtained credentials and has experience in the evaluation, management or diagnosis, and treatment of athletic related injuries. For the purpose of this study, a sports medicine professional included a physician, certified athletic trainer, or a physical therapist.

Sprain. Starkey and Ryan (1994) define a sprain as an injury that occurs when a joint is stretched beyond normal anatomical limits, resulting in the stretching or tearing of the surrounding ligaments and/or joint capsule. For the purposes of this study joint sprains included injury to the distal radioulnar joint and/or injury to the eight intercarpal joints

Wrist joint. The wrist joint has two components, the radiocarpal joint and the distal radioulnar joint (Magee, 1997). In addition to these components, this study included the wrist joint, the intercarpal joints, and the eight carpal bones of the wrist.

Wrist injury. An injury to the wrist joint that may present as either an acute traumatic or an overuse stress injury (Rettig & Patel, 1995). For the purpose of this study, wrist injury was defined only as any acute traumatic injury sustained to the wrist joint.

Project Completion

Data from this study were compiled into a journal article for the *International Journal of Sports Medicine*, according to the *Author's Notes* (see Appendix A).

Summary

Historically, diagnosis and management of injuries sustained to the wrist have been considered an area of debate. Unless an obvious fracture or deformity is observed upon examination, management of a wrist injury historically has been categorized as a “sprain” or “strain” (Honing, 1998; Mooney et al., 1992). Due to the advancement in medical diagnostic technology, clinical research, and training, only recently have medical professionals been given the capacity to properly diagnose these injuries and implement appropriate treatment strategies. Injury to the wrist has been documented to occur in other high-velocity collision sports such as football, but has been lacking in quantity in the sport of baseball (NATA, 1995; NCAA, 2002). Mechanisms of injury to the wrist occur frequently in the sport of baseball and can be observed in every aspect of the game, from sliding into a base to a simple task of swinging a bat. Understanding the mechanisms of wrist injury in the sport of baseball is of extreme importance to the sports medicine professional so that appropriate intervention and proper treatment can be prescribed to minimize time loss and morbidity.

It is apparent through investigative injury surveillance studies conducted by the National Athletic Trainers' Association and the NCAA that injury to the wrist in the sport of baseball is occurring at similar rates when compared to other, higher-risk sports such as football (NCAA, 2002). The occurrence of wrist injury has also been reported at the high school level, through the Injury Surveillance Study conducted by the National

Athletic Trainers' Association (NATA, 1995). In that study, 25% of baseball injuries in 1995 involved the forearm, wrist, or hand, compared to the sport of football where 15% of injuries occurred to the same anatomical area (NATA, 1995). The Injury Surveillance System study conducted by the NCAA reports that, in 2002, while football had 72% more exposures, practice and game injury rates were comparable in baseball (.05 practice, .33 game) and football (.04 practice, .43 game) (NCAA, 2002). However, the study by the National Athletic Trainers' Association did not include collegiate athletes in their sample. Furthermore, the NCAA Injury Surveillance System did not detail the occurrence of wrist injury and its association with field position. Through this research, it is imperative that sports medicine professionals encompass a knowledge and awareness of the risk of wrist injury inherent to a particular sport, in this case baseball, to ensure proper medical treatment is undertaken to prevent a misdiagnosis and minimize time loss and morbidity. The purpose of this study was to investigate the occurrence of wrist injury in collegiate baseball athletes and its impact on field position.

CHAPTER 2

Review of Literature

This chapter was divided into six sections describing the anatomy of the wrist, bony and ligamentous injuries that involve the bones and ligaments of the wrist joint, reference to the incidence of wrist injury in baseball, and instrumentation used. This chapter was composed based on a review of peer-reviewed literature taken from a variety of databases which included Expanded Academic Index, Sport Discus, Wilson Omni, and, Medline.

Anatomy of the Wrist

Bony Anatomy of the Wrist

Mooney, Seigal, and Koman (1992), and Honing (1998), describe the wrist as one of the most complex and least understood joints on the body. Before the significance of the occurrence of wrist injury can be understood, an elementary understanding of the bony and ligamentous anatomy of this complex joint is necessary.

In 1998, Honing described a systematic approach to the anatomy of the wrist that has divided the joint into five zones: radial dorsal, central dorsal, ulnar dorsal, radial volar, and ulnar volar. Howse (1998) also documented this anatomical approach. Honing (1998) viewed this classification of the zones of the wrist important due to the fact that it provides the clinician with distinct palpable areas that can support a diagnosis. Each zone includes soft tissue and bony structures specific to that zone where pain and dysfunction can be identified.

The important bony features seen in the radial dorsal zone are the radial styloid, the scaphoid bone (wrist navicular), the scaphotrapezial joint, and the trapezium. The base of

the first metacarpal and the first carpometacarpal joint are also included in this zone (see Figure 1).

The second zone presented by Howse (1994) and Honing (1998) is the central dorsal zone. The bony structures in this zone include Lister's tubercle of the radius, the scapholunate joint, the lunate, the capitate, the base of the second and third metacarpals, and their respective carpometacarpal joints (see Figure 1).

The ulnar dorsal zone of the wrist joint accommodates the prominent ulnar styloid of the wrist, the distal radioulnar joint, the triquetrum, the hamate, the bases of the fourth and fifth metacarpals, and their own carpometacarpal joints. The triangular fibrocartilage (TFCC) can also be seen in this zone (see Figure 1).

Figure 1. Dorsal view of the wrist. Includes radial (blue), central (yellow), and ulnar (red) zones.

From www.versailus.com.

Howse (1994) and Honing (1998) illustrated that the fourth and fifth anatomical zones of the wrist are viewed from a volar perspective. In the radial volar zone, the bony structures are the scaphoid tuberosity and the tubercle of the trapezium (see Figure 2). Other soft tissue structures included in this zone are the flexor carpi ulnaris, palmaris longus, the long finger flexors, and the median nerve. Although important in the understanding of the anatomy of the wrist, the soft tissue structures in this zone are not included in the scope of this study. According to Goitz and Tomaino (2002), the majority of injuries to the wrist include bony fractures and ligament sprains or tears. The latter may vary in severity from minor sprains to complete tears that result in joint instability. Goitz and Tomaino continue to report that muscle strains that occur at the wrist are minor and respond well to conservative treatment.

The final zone presented by Howse (1994) and Honing (1998) is the ulnar volar zone (see Figure 2). The pisiform, the hook of the hamate, and the ulnar nerve and artery are located within this zone, which can be appreciated at the base of the hypothenar eminence.

Figure 2. Palmar view of the wrist. Includes radial (green) and ulnar (purple) volar zones.

From www.proliteinfo.com/anatofwrist.asp.

Ligamentous Anatomy of the Wrist

Mooney et al. (1992) conducted a review on the ligamentous injury to the wrist. Mooney et al. refers to the ligamentous anatomy as having both intrinsic ligaments and extrinsic ligaments. The intrinsic ligaments called interosseus ligaments, connect adjacent carpal bones together, and separate the intercarpal compartments of the carpus. Most of these intrinsic or interosseus ligaments are labeled in accordance with the bones they connect (i.e., scapholunate ligament) (Mooney et al.). Studies conducted by Koman, Mooney, and Poehling (1990), Mayfield (1984), and Reagan, Linscheid, and Dobyns (1984) have stated that the scapholunate ligament and lunotriquetral ligaments are most important in stabilizing the proximal carpal row. Interruption of these ligaments can lead to proximal row instability and a predisposition to injury.

Mayfield (1984), Mooney et al. (1992), Seigel and Galberman (1991), and Taleisnik et al. (1980) are in agreement that the extrinsic ligaments of the wrist are divided into two groups – radiocarpal and ulnocarpal. The extrinsic radiocarpal ligaments include the radial collateral ligament, dorsal radiocarpal ligament, radioscapophcapitate ligament, radiolunotriquetral ligament, and the radioscapohunate ligament (see Figure 3). All of these ligaments, with the exception of the radiocarpal ligament, are found on the palmar side of the wrist and are the primary stabilizers of the radiocarpal joint. Each ligament arises from the radial styloid and extends to the carpal bone, named as the primary insertion. The extrinsic ligaments studied by Mooney et al. (1992), Seigel et al. (1991), and Taleisnik (1980) include the ulnolunate, the ulnotriquetral, and the

Fig. 3

Figure 4. Ulnar sided ligaments of the wrist. Included is the triangulofibrocartilage complex (TFCC), ulnolunate lig., ulnotriquetral lig., distal radioulnar joint,.

From www.hughston.com.

Injuries to the Wrist

Mechanism of Injury to the Wrist

Halikis and Taleisnik (1996) with contribution from Linscheid and Dobyns (1985) indicated that most sports injuries sustained to the wrist are a result of a compressive load in some degree of extension. Halikis and Taleisnik (1996) continue to state that rotation of the forearm, or wrist, in combination with a flexion-extension or deviating position, is the primary mechanism of injury to a loaded distal radioulnar joint or ulnar carpus. When practically applied to the sport of baseball and the art of hitting these mechanisms occur during each baseball swing attempted. At the point of contact both hands are in a loaded position of ulnar deviation, particularly the bottom hand, due to its involvement with the hard knob of the bat. In 1996, Plancher and Minnich described that during the act of swinging a bat, as the hitter advances through contact of the ball, if the centrifugal force

of the moving knob overcomes the hitters grip on the bat, the impact can cause a fracture, particularly to the hook of the hamate bone.

Rettig and Patel (1995) described the mechanism of scapholunate dissociations or lunotriquetral dislocations to the wrist as either being from a single traumatic blow to the wrist or from repetitive stress. They continue to state that a traumatic force depends on the characteristics of the injurious force, position of the hand at impact, and the individual strength of the bones and ligaments. Atkinson and Baxley (1994) reported that a scapholunate dissociation occurs when a compressive load with the wrist in extension is combined with a pronated forearm with the impact occurring to the thumb. They continue to state that this injury commonly occurs as a result of a twisting motion seen when athletes swing a racquet, club, or bat. In a study conducted by Mayfield, Johnson, and Kilcoyne (1980), successful production of scapholunate dissociations and eventual carpal dislocations were evident after sequentially loading cadaver wrists in extension, radial deviation, and intercarpal supination. Rettig et al. (1995) also described ligament injury of a chronic nature to be attributed to joint hypermobility often seen in athletes, predisposing them to possible serious bony or ligamentous injury to the wrist. This ligament laxity, as seen by Rettig et al., may occur as a result of submaximal loading with the wrist in either, or in combination with an extended, deviated, and supinated position.

Wrist injury occurs as a result of a compressive load with the carpus in some form of extension (Halikis & Taleisnik, 1996; Linscheid & Dobyns, 1985). In addition to this compressive load in extension other accompanying positions are specific to certain injuries to the wrist (Atkinson & Baxley, 1994). Nonetheless, early intervention and

management of a traumatic wrist injury improves the chance that treatment will be successful and long-term; avoiding possible permanent disability (Atkinson & Baxley).

The following two sections highlight five traumatic injuries that have the potential to occur at the wrist through the abovementioned mechanisms. The following injuries have been chosen over others due to the quantity of research documenting evaluation and management of wrist injuries in athletes.

Fractures of the Wrist

Scaphoid Fractures.

The scaphoid bone operates as a bridge between the proximal and distal carpal rows of the wrist. Due to this unique position the scaphoid is more susceptible to injury than any other carpal bone (Honing, 1998). A fracture that is sustained to the scaphoid bone generally occurs after a fall on an outstretched arm with an extended wrist (Honing, 1998; Plancher et al., 1996). The problem with a fractured scaphoid is that an injury of this nature, in the anatomical area known as the wrist, will not necessarily present as a fracture on a standard radiograph. Morgan and Linder (1997) reported that acute scaphoid fractures are frequently missed because these initial radiographs appear unremarkable. It has been reported that as much as 80% of scaphoid fractures have been documented to occur through the middle of the scaphoid, 20% occur at the proximal pole, and 10% occur through the distal pole (Honing, 1998; Mirabello, Loeb, and Andrews, 1992; Morgan & Linder, 1997). Another dilemma accompanying scaphoid fractures is the tenuous blood supply that it receives and the frequency of avascular necrosis and the development of a non-union fracture that sometimes occurs following injury. Only one

artery, located on the dorsoradial aspect, provides this bone with blood and nutrients. This results in a 100% incidence of avascular necrosis in proximal pole fractures and 30% incidence in distal fractures (Honing, 1998; Mirabelo et al., 1992). Approximately 95% of non-displaced scaphoid fractures have been documented to heal if immobilized promptly in a short arm thumb spica cast for as long as 12 weeks (Morgan & Linder, 1997). Displaced scaphoid fractures are treated with internal fixation with K-wires followed by extended cast immobilization (Morgan & Linder, 1997). This incidence, however, has not previously been documented with respect to the sport of baseball.

Hook of the Hamate Fractures.

A fracture to the hook of the hamate bone is relatively uncommon and occurs in only 2% of all carpal fractures, with the diagnosis of this fracture often being delayed (Boulas & Milek, 1990). Patients usually do not seek medical attention immediately because their symptoms are often very vague (Honing, 1998). One of the functions of the hook of the hamate is to act as a pulley for the flexor of the little finger of the hand. Pain and weakness during grasping activities usually prompts the patient to seek attention. Due to the fact that a fracture of the hook of the hamate is a compression injury (Plancher et al., 1996), sports involving a bat, racquet, or a club, therefore, are at a greater risk for a hook of the hamate fractures.

Morgan and Linder (1997) documented that fractures to the body of the hamate are rare and, if isolated, unimportant. However, a fracture to the hook of the hamate is important and frequently misdiagnosed as a sprain or strain. O'Brien (1984) supports this claim. Morgan and Linder (1997) continue to report that treatment of acute non-displaced

fractures to the hook are treated conservatively with the athlete missing up to six weeks due to cast immobilization. Thus, certain skills inherent to the sport of baseball, particularly swinging a bat, sliding into a base, or making a catch against a wall, have the potential to cause serious and debilitating injury. If not identified in a timely manner, these injuries can produce a decrease in performance and possible long-term instability.

Ligamentous Injuries Occurring to the Wrist

Scapholunate Dissociation.

Halikis and Taleisnik (1996) described ligament laxity as occurring often as a result of a collision injury or by pre-existing laxity in the athlete. Atkinson and Baxley (1994) reported that wrist injury can also occur, or be exacerbated by, repetitive loading with a dorsiflexed wrist and the forearm pronated.

Dobyns, Linsheid, and Chao (1975) proposed two primary patterns in the first formal attempt to classify post-traumatic carpal instability. They stated that the lunate represented the intercalated segment between the distal row and the radius. One pattern of instability proposed by Linsheid et al. (1985) was dorsiflexed intercalated segment instability, or DISI. Dobyns et al. (1975) recognized that dorsal instability was present when the lunate dorsiflexed and shifted palmarly under a compressive load, contributing to scapholunate dissociations. Atkinson and Baxley (1994) also reported similar findings, and report that, together; the scaphoid and lunate provide stability to the wrist. Under normal conditions, the scaphoid moves with the lunate. Atkinson and Baxley continued to state that following wrist injury, a disruption in the relationship between the scaphoid and lunate occurs, causing a breakdown in the stability of the wrist joint. The result is a

subluxation of the lunate and dissociation between the scaphoid and lunate bones. Injury to the scapholunate couplet not only destroys the scapholunate joint, but can also increase the risk of destructive injury to the radioscaphoid, capitolunate, and hamate-lunate joints (Atkinson & Baxley, 1994). Closed and open reduction surgery with internal fixation has been used, however Halikis and Taleisnik (1996) advocate the open reduction technique for DISI deformities or scapholunate dissociations in athletes. However, no research on the effectiveness of an open reduction with internal fixation on these wrist injuries in collegiate baseball athletes currently exists.

Atkinson and Baxley (1994) reported that the treatment of scapholunate dissociations depends on the relationship between the onset of the acute injury and clinical presentation. The majority of scapholunate dissociations are examined as long as three weeks after injury; which lacks prompt treatment. Common symptoms associated with scapholunate dissociations involve the athlete complaining of prolonged, increasing pain, particularly in the radial side of the wrist that has limited activity. Operative reconstructive repair of the injured ligaments is recommended in athletes with an unstable scapholunate joint, followed by 8 to 12 weeks of immobilization, with an additional 3 to 6 weeks of protection and rehabilitation (Atkinson & Baxley).

Perilunar Dislocations.

Dobyns et al. (1975) termed another pattern of carpal instability, volarflexed intercalated segment instability (VISI). Dobyns et al. proposed, with the presence of VISI instability, under a compressive load, the lunate flexes volarly together with the natural volar flexion of the scaphoid, producing a perilunar dislocation (triquetral-lunate

dissociation). The main complaint with an athlete with this type of injury is pain on the dorsoulnar side of the wrist, localized to the lunotriquetral joint. Steroid injections and immobilization above the elbow are considered recommended treatment in cases of VISI instability without a demonstrable tear of radiocarpal ligaments (Halikis et al., 1996).

Raab, Fisher, and Quick (1994) reported treatment of perilunar dislocations. In this study, the authors conducted a five-year retrospective study on lunar and perilunar dislocations in professional football players. During the five-year study 7 lunar and 3 perilunar dislocations were reported in 10 professional football players. The mechanism of injury in 9 of the 10 athletes was forced dorsiflexion of the wrist, such as falling on an outstretched hand. In all 10 cases, surgical intervention with fixation (open or closed) surgery was conducted. Following reduction carpal alignment was considered satisfactory in 90% of participants. Immobilization consisted of a long (for four players) or short arm cast (for six players) for at least 6 weeks. Following immobilization, surgical pins were removed and subjects began rehabilitation. Five of the ten participants eventually returned to play. The total loss of playing time among these five players was as long as 13 weeks.

In summary, radiographic findings of DISI and VISI patterns are associated with significant ligamentous instability. It is apparent that, in situations where carpal instability is present, DISI or VISI, an extended period of immobilization is warranted to re-establish normal kinematics of the wrist joint (Mooney, Siegal, & Koman, 1992). It is imperative with injuries of this nature; timely intervention is necessary to prevent long-term dysfunction.

Triangulofibrocartilage Complex (TFCC) Injury.

Halikis and Taleisnik (1996) described injury to the TFCC as a tearing of the fibrocartilaginous disk that lies over the ulnar head. Halikis et al. (1996) also described this meniscal homologue as a stabilizer to the distal radioulnar joint and the ulnar continuation of the radius, providing an articular surface for the proximal carpus. Morgan and Linder (1997) have contributed to the importance of the TFCC by reporting that the TFCC acts as a stabilizer to the distal radioulnar joint, buffering the forces during grasping activities.

Traumatic tears of the TFCC have been classified into four types (Palmer, 1989). Palmer classified a type 1A as a central tear of the disk, a type 1B as an avulsion from the ulnar attachment a type 1C as a peripheral tear from the lunate and triquetrum, and a type 1D as an avulsion from the radial attachment. A predisposing factor to TFCC tears refers to the thickness of the disk, termed ulnar variance, predisposes an individual to TFCC tears (Honing, 1998). Thickness variance affects the axial load borne by the ulna. In the normal wrist the load distribution between the radius and the ulna are 82% and 12% respectively (Honing). Halikis et al. (1996) reported that in positive ulnar variance, the TFC is thinner resulting in more transmitted forces. Halikis et al. described that a positive ulnar variance of 2.5 millimeters a (thinner disk), visible on plain film radiography, was found to increase the load transmitted through the ulna to 42%, making the TFCC more susceptible to injury. Halikis et al. described treatment for acute injury to the TFCC, without dislocation or subluxation, as a long arm cast with the wrist in neutral for 4 to 6 weeks. Honing (1998) suggested that the wrist be placed in slight flexion and ulnar

deviation to maximize healing. Honing and Halikis et al. also agree that corticosteroid injection may be helpful in both diagnosis and treatment of TFCC injury.

Surgical intervention has been indicated for a stable wrist that remains symptomatic and becomes chronic (Bowers, 1985; Halikis et al., 1996; Honing, 1998; Palmar, 1987). Halikis et al. (1996) and Honing (1998) included surgical options that debride the localized defects, and decompress the ulnocarpal space by excising a portion of the distal ulna to correct for positive ulnar variance. Despite the documentation of possible treatment options, both conservative and surgical, research as to the time lost from competition due to immobilization is lacking.

Incidence of Wrist Injury in Athletics

Currently, reporting systems on the incidence of injury in athletics in the United States have been limited to the NCAA Injury Surveillance System, and the National Athletic Injury/Illness Reporting System. The incidence of injury in high school athletes has also been limited to the Injury Surveillance System conducted by the National Athletic Trainers' Association (NATA). In 1995 the NATA initiated a 3-year study to determine the trend of high-school injuries in ten sports, including high-school baseball, in order to provide certified athletic trainers with current information that would allow certified athletic trainers to meet the needs of their athletes in a particular sport (NATA, 1995). During this study injury data for high-school baseball was collected from 110 high-school baseball teams from September 1 through July 15. Injury categories were labeled as mild, moderate, or major. Mild injuries were defined as any injury that caused the athlete to be removed from the remainder of the current session and returned to

activity within seven days. Moderate injuries were graded as injuries that forced the removal of the athlete from the current session with return to activity and the athlete did not return to activity within seven days and did not return for as much as 21 days. Injuries that prompted the removal of the athlete from activity for more than 21 days were classified as major. Sprains were defined as any injury involving the ligamentous tissue about the joint. Fractures assumed the typical definition of injury involving some type of bone trauma.

Results from this study reveal that 25% of baseball injuries involve the forearm, wrist, or hand, compared to 15% of all football injuries occurred in the same anatomical area. Furthermore, 16 % of all injuries were classified as sprains. The occurrence of fractures to high-school baseball players was not reported in this study. Over the course of this study, 77% of injuries sustained by baseball athletes were considered minor, 13% were moderate, and 11% of injuries were classified as major. Injuries that occurred during practice or game were 52% and 49%, respectively. Approximately 10% of the injuries observed in this study were suffered by center fielders and shortstops.

The previous study reported by the National Athletic Trainers' Association (1995) has documented the incidence of wrist injury as it related to high school baseball. This study identified that a considerable number of athletes suffer from wrist injuries. However, the study conducted by the National Athletic Trainers' Association did not provide data as to the occurrence of wrist injury experienced at the level of collegiate athletics. Based on the fact that the collegiate athlete is often more mature than that of a high school athlete and coupled with the faster-paced nature of collegiate baseball,

important questions need to be asked. Is the collegiate baseball player at a greater risk of encountering a wrist injury that could possibly end their season, or worse, career? If so, which position on the field possesses the greatest risk of suffering an injury of this magnitude? Which type of wrist injury do collegiate baseball players most frequently encounter?

Injury surveillance at the collegiate level began in 1982 with the emergence of the Injury Surveillance System developed by the NCAA. The NCAA collects injury data yearly from a representative sample of member institutions. Based on the data, reviewed by the NCAA Committee on Competitive Safeguards and Medical Aspects of Sports, the Injury Surveillance System is meant to serve as a tool used to reduce injury rates inherent to a particular sport (NCAA, 2002). Participation in the Injury Surveillance System is voluntary, but limited to NCAA member institutions. Participants are selected from the populations of institutions by stratified random sampling, with a minimum of 10% representation from each NCAA division (I, II, III), and each region of the country (East, West, South, and Midwest).

This Injury Surveillance System has defined injury as one that 1) occurred as a result of participation in an organized intercollegiate practice or game, 2) required medical attention by a team athletic trainer or physician, and 3) resulted in restriction of the student-athlete's participation for one or more days beyond the day of the injury. The Injury Surveillance System has not classified injury as being minor, moderate or major, nor has it revealed injury rates as they pertain to particular anatomical areas. The Injury Surveillance System was designed to measure injury rates in 16 collegiate sports and has

classified injury rate as a ratio of the number of injuries in a particular sport to the number of athletic exposures (A-E) in that sport. An athletic exposure, as defined by the Injury Surveillance System, is the risk that one athlete during one practice or game is exposed to injury. For example, 60 athletes participating in five practices, and those same athletes participating in two games, would produce a total of 420 A-E for a particular week. The Injury Surveillance System expresses injury rate as injuries per 1,000 athletic A-E's. These injury rates were calculated for practice injury rates, game injury rates, practice injury rates resulting in a loss of seven days or more, game injury rates resulting in a loss of seven days or more, and both practice and game injury rates that required surgery.

Beginning in 1999 for only baseball injuries, results from four consecutive surveys conducted by the NCAA revealed that approximately 37% of injuries resulted in more than 7 days of loss, while eight wrist injuries required surgery. The Injury Surveillance System also reported that the base runner was at the highest risk of injury. Due to sliding, the base runner accounted for 27% of all injuries reported. However, the Injury Surveillance System study did not provide a description as to which aspect of sliding contributed to wrist injury. The annual Injury Surveillance System study did not report wrist injury data by field position, nor did this study speculate as to which type of wrist injury was sustained.

Incidence of wrist injury in athletics has been reported at both the high school and collegiate level (NATA, 1995; NCAA, 2002). Unfortunately, the study investigated by the NATA, while reporting a relationship between wrist injury and field position, did not

observe the incidence of wrist injury outside the high school population. Conversely, during the years in which the NCAA conducted the Injury Surveillance System studies, the incidence of wrist injury in collegiate athletics including baseball was observed. However, the absence of the inclusion of field position in these studies, did not allow the investigators of the Injury Surveillance System studies to relate the occurrence of wrist injury to position on the field. The two reports by both the National Athletic Trainers' Association and the NCAA provide the design for this proposed study. This study examined the incidence of wrist injury at the collegiate level and its association to field position in collegiate baseball athletes.

Summary

Numerous injuries occur to the wrist that can seriously restrict an athlete from performing to the best of their ability. Research has indicated that the management of athletic related wrist injuries involve the injured athlete to be immobilized for a minimum of 3 weeks and as long as 13 weeks (Atkinson & Baxley, 1994; Morgan & Linder, 1997; Raab et al., 1994). In addition, although a major contributor to injury incidence in collegiate athletes, aside from the annual Injury Surveillance System survey conducted by the NCAA, there is a lack of research regarding the effects that wrist injuries have on collegiate baseball athletes.

Due to the inherent differences between high school and college athletes, both on success and performance, incidence and occurrence of wrist injuries to baseball athletes may predispose them to painful and prolonged disability. The annual Injury Surveillance System surveys conducted by the NCAA are very informative and report that on the

surface wrist injuries are occurring to collegiate baseball players. This survey also provided insight into possible mechanisms to wrist injuries, however, did not included statistics on the relationship, if one exists, between the occurrence of wrist injury and field position.

Outside the commonly occurring task of swinging a bat, certain field positions require specialized skills. Traditionally, the fastest athletes are considered a threat to stealing bases. Stealing a base often requires a head first slide in order to be successful. Additionally these types of athletes traditionally occupy second base, shortstop, or any of the three outfield positions. A question that is important to address in understanding this issue requires investigating how these skills, inherent to the sport of baseball have on the occurrence of wrist injury. Which field position, at the collegiate level, is at greatest risk of wrist injury? The examination of this question bears the potential to offer certified athletic trainers and other health care professionals possible risk factors that occupying particular positions entail.

This information may provide an efficient evaluation and management of an injury of this magnitude. Therefore, the purpose of this study was to investigate the association of field position on the occurrence of wrist injury in collegiate baseball athletes. This information may provide the health care professional with important information that pertains to specific injuries that are inherent to collegiate athletes that play specific positions in the sport of baseball.

CHAPTER 3

Methods

Injury to the anatomical location commonly known as the wrist occurs in athletics (Atkinson & Baxley, 1994). If not detected early in the injury process wrist injuries have the potential to cause possible season-threatening injury due to pain, dysfunction, and long-term morbidity (Atkinson & Baxley, 1994; Morgan & Linder, 1997; Raab, Fisher, & Quick, 1994).

Historically, the incidence of wrist injury and its occurrence in the sport of baseball, continue to be investigated through two Injury Surveillance System (ISS) studies conducted by both the National Athletic Trainers' Association (NATA) (1995) and the National Collegiate Athletic Association (NCAA) (2002). The National Athletic Trainers' Association did reveal an underlying relationship between the occurrence of wrist injury and field position. Unfortunately, this study was limited to observations of high school athletes, not collegiate athletes. Conversely, study conducted by the NCAA included intercollegiate athletes, but did not attempt to elaborate on the relationship between the occurrence of wrist injury and field position. Thus, the purpose of this proposed research study was to examine the association of field position on the occurrence of wrist injury in collegiate baseball athletes.

The purpose of this chapter was to present the methods that were used to investigate the impact of field position on the occurrence of wrist injury in collegiate baseball athletes. The chapter is presented in four sections: participants, instrumentation, procedures, and the analysis of data.

Participants

One hundred and twenty-five intercollegiate baseball athletes that currently play any of the eight field positions, excluding pitcher, volunteered to participate in this investigation. Participants that act as the designated hitter were also included in this population. Participants were chosen from eight intercollegiate baseball programs located in the San Francisco Bay area. Participating institutions include: San Francisco State University, University of San Francisco, San Jose State University, Ohlone College, Santa Clara University, Gavilan College, Monterey Peninsula College, and Cabrillo College. These particular baseball programs were chosen based on their collective representation of a sample of four-year and community college intercollegiate athletic institutions located in the San Francisco Bay area. Prior to testing, permission to conduct the research study was granted by the Athletic Director or Associate Athletic Director from each institution (see Appendix B). Each participant was administered an interview questionnaire that was administered by the investigator (see Appendix C).

Instrumentation

Using previous research methods as a basis, an interview questionnaire was constructed by the researcher and was used to collect wrist injury data from participants (see Appendix C). The "Occurrence of Baseball-Related Wrist Injury Interview Questionnaire" (OBWI) contains 16 items divided into two sections: 1) demographic data (age, year of eligibility, and primary field position), and 2) 13 questions designed to establish the occurrence and nature of wrist injury sustained at some point in the participants baseball career. A panel of experts in the field of health care reviewed the

questionnaire for face validity. This panel included two orthopedic physicians with ten years experience, and seven certified athletic trainers with a minimum of a Masters degree in the field of Sports Medicine and seven years experience in the field of Sports Medicine. One member of the panel has a bachelor's degree in Physical Education and 15 years experience as a certified athletic trainer. Each panel member was mailed a letter with information about the purposes of the study, and specific instructions on completion and evaluation of the interview questionnaire (see Appendix D). This letter incorporated a sample interview questionnaire for their review, which included a section for professional evaluation. Review of the interview questionnaire identified additional items that needed to be added to produce comprehensive data. Sequential ordering of the questionnaire was suggested to allow smooth administration of the interview questionnaire. The questionnaire was modified accordingly.

The content of the questionnaire includes three sections of demographic data on each participant, including age, and year of eligibility (Freshman, Sophomore, Junior, Senior, Transfer, Medical Redshirt, or Redshirt), and primary field position (outfielders, middle infielders, catchers, first base players, or third base players). Members of the middle infielder included both shortstop and second base players. Participants divided from each field position categories also participate in the act of hitting during the offensive portion of the contest and thus are included as offensive players in addition to their defensive field position.

The second portion of the "Occurrence Of Baseball-Related Wrist Injury Interview Questionnaire" contains 13 items that have been developed using previous research to

establish the presence of a wrist injury (NATA, 1995; NCAA, 2002). The first two items on the interview questionnaire are based on inclusion criteria from the NCAA Injury Surveillance System (NCAA, 2002). Item 3 was created to report where (college, high school, or little league) and when (years) the injury took place. Item 4 was created from past research to establish a mechanism of injury (Atkinson & Baxley, 1994; Halikis & Taleisnik, 1996; Mayfield, Johnson & Kilcoyne, 1980; Rettig & Patel, 1995). Item 5 was established from past research in an attempt to classify wrist injury in one of the five anatomical zones (Honing, 1998; & Howse, 1994). Data from this question were collected by having the participant point to the location of wrist injury on their wrist (see Appendix E). The investigator then marked that location according to the concurrent anatomical zone. Item 6 was adopted from the inclusion criteria of the NCAA Injury Surveillance System and expanded to include other health care professionals that have the ability to render health care (NCAA, 2002). Item 7 was generated to report on the time in which it took the athlete to seek medical attention (Boulas & Milek, 1990). Items 8 and 9 were established to report any recollection to the nature or diagnosis of the injury (Honing, 1998; Mooney, Seigal & Koman, 1992). Items 10 and 11 were adopted from the NATA Injury Surveillance System to classify the severity of the injury. These two items reflect the severity of wrist injury by establishing the exact amount of competition (measured in days) missed due to injury (NATA, 1995). Item 12 was also adopted from the NCAA Injury Surveillance System to report on any intervention needed to correct the injury (i.e. surgery, casting, bracing, splinting). Based on past research, Item 12 was expanded to document the amount of time lost due to immobilization (Atkinson &

Baxley, 1994; Mooney et al., 1997; Morgan & Linder, 1997; Raab, Fisher, & Quick, 1994). Item 13 was generated in an attempt to determine the percentage of games in which the athlete participated in before and after sustaining a wrist injury.

In totality, the questionnaire was completed as an amalgamation of past research on wrist injuries in order to obtain rich and detailed information on collegiate baseball players' wrist injuries.

The interview questionnaire was administered by the investigator during the stretching and warm-up portion of a practice session in an attempt to facilitate the completion of the questionnaire, ensure quality of the data collected, maximize one on one conversation, and minimize practice disruption.

Procedures

Prior to testing, the Athletic Director or Associate Athletic Director from each of the eight participating institutions granted the investigator permission to conduct research on the collegiate baseball athletes at their institution (see Appendix B). Permission to conduct this investigation was granted by the Institutional Review Board at San Jose State University (see Appendix G). On the day of testing, the investigator personally administered the "Occurrence of Baseball-Related Wrist Injury Interview Questionnaire" to each participant (see Appendix C). The interview questionnaire was administered during the stretching and warm-up portion of an in-season practice session. During this time, practice disruption is minimal and it provides one on one conversation. The interview questionnaire was administered beginning with the first item and was completed when the last item was answered. In the case where an athlete has not

sustained a wrist injury, only demographic data were collected. In the instance where a participant has suffered multiple wrist injuries, additional questionnaires were administered for each injury. Questionnaires were then compiled together with the same institution identification code for analysis. Test time was expected to take the participant a maximum of five minutes to complete. Each participant was informed that consent to participate is implied upon completion of the interview questionnaire. Upon consent to participate, the interview questionnaire was administered to each field position player by the investigator. Each participant was provided a copy of the consent form upon completion of the interview questionnaire (see Appendix F). Data collection was completed when each position player on the current roster, present on the day of testing, completed the interview questionnaire.

Analysis of Data

Demographic data were analyzed using descriptive statistics including: mean, range, standard deviation and percentages. In addition, cross-tabulation tables and η^2 analysis were created for essential variables to determine the association between field position and the occurrence of wrist injury. SPSS (SPSS 2003, version 11.0) was used to calculate data collected in this research study.

Summary

For many years the lack of diagnostic technology and medical training has produced incomplete diagnoses for the evaluation and management of athletic related wrist injury. Unless an obvious fracture or deformity was detected, injury to the wrist has been given the diagnosis of a “sprain” or a “strain”. Only recently, through the emergence of more

precise diagnostic technology, education, and medical training, has this diagnosis been altered, and a more specific diagnosis administered to ensure optimal medical treatment. Labeling a wrist injury as a “sprain” or “strain” is no longer acceptable. If this misdiagnosis occurs, and a serious wrist injury is dismissed as a “sprain” or “strain”, season-ending, and possible career-threatening injury can result from chronic pain and dysfunction. Health care professionals must encompass more than an elementary understanding of the occurrence of wrist injury in athletics and the possible injuries that can result from athletic competition. Traumatic injury to the wrist has been previously documented to result in an athlete’s removal from competition for as many as 13 weeks for immobilization and rehabilitation (Atkinson & Baxley, 1994; Morgan & Linder, 1997; Raab et al., 1994). This outcome drastically reduces the likelihood of one of these athletes returning to competition the same season, and has the potential for long-term morbidity. Wrist injuries that are misdiagnosed or not treated in a timely manner may drastically limit future competition and the overall stability of the injured wrist (Honing, 1998).

Through multiple surveillance studies conducted at the high school and college level, it is apparent that injury to the wrist joint is occurring in an athletic setting (NATA, 1995; NCAA, 2002). However, research on the association of field position and the occurrence of wrist injury are lacking.

Particular skills inherent to the sport of baseball, place these particular athletes in a vulnerable position and increased risk of suffering a traumatic injury to the wrist. Varying from the most elementary skills of swinging a bat, to sliding into a base, these

mechanisms place the wrist in positions that have been documented to cause complicated injuries to the anatomical location known as the wrist (Atkinson & Baxley, 1994; Halikis & Taleisnik, 1996; Linscheid & Dobyns, 1985; Rettig & Patel, 1995). Particular players that are exposed to documented mechanisms are predisposed to certain traumatic wrist injuries.

Strategically, the fastest players are common threats to steal a base, which, historically occupy either middle infield positions or one of the three outfield positions. The risk of baseball players suffering a traumatic wrist injury is escalated when this individual attempts a slide, often head first with the wrist extended, to increase the chances of being called safe. Sliding exposes the athlete to an environment that may predispose them to injury by placing the wrist in a position that has been observed to cause scaphoid fractures, joint dislocations, and TFCC tears (Halikis & Taleisnik, 1996; Linscheid & Dobyns, 1985).

The task of swinging a bat is elementary in the sport of baseball, and its occurrence is necessary for the game to progress, but has been reported to place abnormal forces on the wrist, potentially causing fractures to the hook of the hamate bone (Plancher & Minnich, 1996).

The occurrence of position-related wrist injury in collegiate baseball, and its possible complications, compels physicians and certified athletic trainers to have a coherent understanding of mechanisms of wrist injury, its evaluation, and possible treatment options which may allow for timely intervention. Prompt diagnosis and treatment can ensure optimal care to the injured athlete and decrease the potential of possible season-

ending injury or future sequelae due to pain and instability. Therefore, the purpose of this research study was to investigate the association of field position on the occurrence of wrist injury in collegiate baseball athletes.

Project Completion

Data from this study were compiled into a journal article for the *International Journal of Sports Medicine*, according to the *Author's Notes* (see Appendix A).

REFERENCES

- Anderson, K.N., Anderson, L.E., & Glanze, W.D. (Eds.), (1994). Mosby's medical, nursing, and allied health dictionary (4th ed.) St. Louis: Mosby.
- Atkinson, L.S., Baxley, E.G. (1994). Scapholunate dissociation. *American Family Physician*; 49(8), 1845-1851.
- Boulas, H.J., Milek, M.A. (1990). Gymnastic wrist injuries. *Orthopedic Reviews*; 19(6), 518-529.
- Bowers, W.H. (1985). Distal radioulnar joint arthroplasty. The hemiresection interposition technique. *American Journal of Hand Surgery*; 10(2), 169-178.
- Dobyns, J.H., Linscheid, R.L., Chao, E.Y.S. (1975). Traumatic instability of the wrist. In *AAOS Instructional Lectures*; (pp. 182-199). St. Louis, MI: CV Mosby.
- Gabel, G.T. (1998). Gymnastic wrist injuries. *Clinics in Sports Medicine*; Jul 17(3), 611-621.
- Goitz, R.J., Tomaino, M.M. (2002). Traumatic hand injuries: evaluation and management; understanding of the complex anatomy is the key to diagnosis. *The Journal of the Musculoskeletal System*; 19(5), 204-206.
- Halikis, M.N., Talesnik, J. (1996). Soft-tissue injuries of the wrist. *Clinics In Sports Medicine*; 15(2), 235-258.
- Honing, E.W. (1998) Wrist injuries. Part 1: pinpointing pathology in a complex joint. *The Physician and Sports Medicine*; 26(9), 40.
- Honing, E.W. (1998). Wrist injuries. Part 2: spotting and treating troublemakers. *The Physician and Sports Medicine*; 26(10), 62.

- Howse, C. (1994). Wrist injuries in sport. *Journal of Sports Medicine*; 17(3), 163-175.
- Koman, L.A., Mooney III, J.F., Poehling, G.G. (1990). Fractures and ligament injuries of the wrist. *Hand Clinicals*; 6(477), 477-491.
- Linsheid, R.L., Dobyns, J.H. (1985). Athletic injuries of the wrist. *Clinical Orthopaedics*; 198, 141-151.
- Mayfield, J.K. (1984). Patterns of injury to carpal ligaments: a spectrum. *Clinical Orthopaedics*; 187, 36-42.
- Mayfield, J.K., Johnson, R.P., Kilcoyne, R.K. (1980). Carpal dislocations: pathomechanics and progressive perilunar instability. *American Journal of Hand Surgery*; 5(3), 226-241.
- Mirabello, S.C., Loeb, P.E., Andrews, J.R. (1992). The wrist: field evaluation and treatment. *Clinics In Sports Medicine*; 11(1), 1-25.
- Mooney III, J.F., Seigel, D.B., Koman, A.L. (1992). Ligament injuries of the wrist in athletes. *Clinics In Sports Medicine*; 11(1), 129-139.
- Morgan, R.L., Linder, M.M. (1997). Common wrist injuries. *American Family Physician*; 55(3), 857, 869.
- National Athletic Trainers Association. (1995). Injury Surveillance Study
- National Collegiate Athletic Association. (2002). NCAA Injury Surveillance Study.
- O'Brien, E.T. (1984). Acute fractures and dislocations of the carpus. *North American Journal of Clinical Orthopaedics*; 15, 237-258.
- Palmer, A.K. (1987). The distal radioulnar joint: anatomy, biomechanics, and triangular fibrocartilage abnormalities. *Hand Clinicals*; 3, 31-40.

- Palmer, A.K. (1989). Triangular fibrocartilage lesions: a classification. *American Journal of Hand Surgery*; 14(4), 594-606.
- Plancher, K.D., Minnich, J.M. (1996). Sports-specific injuries. *Clinics In Sports Medicine*; 15(2), 207-218.
- Raab, D.J., Fisher, D.A., Quick, D.C. (1994). Lunate and perilunate dislocations in professional football players: a five-year retrospective analysis. *American Journal of Sports Medicine*; 22(6), 84-89.
- Reagan, D.S., Linscheid, R.L., Dobyns, J.H. (1984). Lunotriquetral sprains. *Journal of Hand Surgery*; 9A, 502-514.
- Rettig, A.C., Patel, D.V. (1995). Epidemiology of elbow, forearm, and wrist injuries in the athlete. *Clinics In Sports Medicine*; 14(2), 289-297.
- Seigel, D.B., Gelberman, R.H. (1991). Radial styloidectomy: an anatomical study with special reference to radiocarpal intracapsular ligamentous morphology. *Journal of Hand Surgery*; 16A, 40-44.
- Starkey, C., Ryan, J. (1996). The wrist, hand, and fingers. In Spraggins, C., Massey, R. (Eds). *Evaluation of Orthopedic and Athletic Injuries*; Philadelphia, PA: WB Saunders.
- Talesnik, J. (1980). Posttraumatic carpal instability. *Clinical Orthopaedics*; 149, 73-82.

Appendix A

Authors' Notes for the International Journal of Sports Medicine

Information for Authors

Scope of the Journal

The International Journal of Sports Medicine (IJSM) provides a forum for the publication of papers dealing with basic or applied information that will advance the field of sports medicine and exercise science. The following sections define the scope of the journal: training & testing; orthopedics & biomechanics; clinical sciences; nutrition; behavioral sciences; physiology & biochemistry; immunology.

General Policy

The journal publishes original papers, reviews, short communications and letters to the Editors. Manuscripts submitted to the journal must contain novel data on theoretical or experimental research or on practical applications in the field of sports medicine and exercise science. No substantial part of the submission should have been published elsewhere. If a part of the submission has been published or presented on a congress, symposium, or national meeting proceeding, the reference for that publication and/or presentation should be given in the manuscript acknowledgement section. Submitted papers undergo peer reviewing by two independent referees. Authors may suggest names and full addresses including telephone and FAX numbers of two referees but not from their own institution.

Categories of articles accepted for review

Original articles: Theoretical or experimental (basic or applied) research or practical applications. Either original work or the replication of work that better establishes basic principles will be considered. Original articles should not exceed a total of 15,000 characters, including references.

Review articles: Review articles on topics of broad interest are desirable. Authors who wish to submit an unsolicited review article should correspond with the Editors-in-Chief to determine the timeliness of the proposed review article. The correspondence should include an abstract and a complete outline of the proposed review article, including figures and tables (if possible). Review articles should not exceed 30,000 characters, including references. Review articles are considered by the Editors and expert referees before a final decision regarding publication is made.

Rapid communications: Short manuscripts containing results of unusual scientific interest and importance, requiring rapid publication. Papers submitted for this accelerated process must require little or no revision. Accompanying the submission should be a letter from the authors stating why they feel the paper should be published as a rapid communication. The manuscripts must not exceed four journal pages (2500 words).

including figures, tables and references). The format is the same as for full papers. For articles submitted as Rapid Communications every effort will be made to make a decision within three weeks and publish it within two or three months. Manuscripts rejected as Rapid Communications are eligible for resubmission as regular articles.

Letters to the Editor are welcome and will be published if appropriate. Letters (maximum length 700 words) relating to material previously published in IJSM should be submitted within 6 months after publication of the material the letter is referring to. Such letters will be sent to the corresponding author for comment within six weeks. The original letter and any reply will be published concurrently.

Preparation of the submission

General: Each submission must come with a cover letter containing the following information:

- title of the article and authors' names;
- statement that the manuscript is not under consideration for publication by any other journal;
- statement indicating that each author has contributed substantially to the submitted work and has reviewed and agrees with the submission of the manuscript for review (please note: authorship may not change during review process);
- statement indicating that the corresponding author will cover the page charge starting from the fourth printed page;
- a signature by each author, or at minimum the senior author with the authority from the coauthors.
- If the reader is referred to previous work by the same authors, particularly in relation to methodology but also if a previous concurrent article is unpublished, copies or reprints of the other publications should be sent with the original submission.

Electronic Submissions

Send a disk to the Editorial Office, or send an e-mail with the manuscript attached. Tables and figures must be included, though print quality/high-resolution (color/grayscale 300 dpi, graphics/line drawings 800 dpi) will only be required for accepted manuscripts. We encourage all electronic submissions in PDF format; MSWord files will also be accepted. Please indicate the file type (and version) in the text of the e-mail. Maximum acceptable file size is 2 MB.

Paper Submissions

Format: Manuscripts must be typed legibly on standard paper no larger than 21x29.7 cm (DIN A4) with a 3 cm margin on the left, font 12 point, double spaced. The pages must

be numbered in sequence beginning with the title page as page number one. The lines of each page must be numbered consecutively beginning with the title page.

Four copies of the manuscript are required, one original (with illustrations suitable for reproduction) and three complete copies including copies of illustrations and tables.

Style: Manuscripts may be rejected without review on the basis of poor English or lack of conformity to stated standards of style.

Title page: The title page of the manuscript should contain the following information:

- specification of the most appropriate section of the journal (as listed above under Scope of the Journal);
- concise but informative title;
- authors' names with first and middle initials (do not include degrees);
- short concise running title (not exceeding 45 characters including spaces) for presentation on the journal cover;
- name and location of the institution(s) where the work was undertaken;
- name and address of the corresponding author and author to whom official correspondence and reprint requests should be addressed that must include telephone and fax numbers and an e-mail address.

Abstract page: The abstract should be informative. It should be self-explanatory without reference to the text of the manuscript. It should include essential significant results that support the conclusion of the work. Three to six key words not used in the title should also be provided. Abbreviations should not be used in the abstract.

Introduction: Should be comprehensible to the general reader. Give a clear statement of the purpose of the paper and provide relevant context to support the basis for the paper and the significance of the work. Do not exhaustively review the literature.

Materials & Methods: Provide sufficient information in the text or by reference to other work to permit the submitted work to be repeated without the need to communicate with the authors. Relevant validity and reliability data should be provided for critical methods.

State the type of statistical tests used. Include the number of observations and the statistical findings when appropriate. Parametric and non-parametric statistics must be used as appropriate.

Results: Should be presented precisely and should not contain material that is appropriate in the discussion. Units, quantities, and formulas should be expressed according to the Systeme Internationale (SI units). All measurements should be given in metric units.

Discussion: Emphasize the new and important aspects of the study and conclusions derived from the study.

Acknowledgements: Reference to prior publication of the results in abstract form or in proceedings should be provided. Addresses of authors other than the laboratory acknowledged for the work should be provided. Financial support should be stated.

References: References should be cited in the text by number and compiled alphabetically at the end of the article and numbered accordingly. Titles of journals should be abbreviated according to the latest edition of Index Medicus. All authors should be named (do not use "et al."). Authors bear complete responsibility for the accuracy of the references.

Only published or "in press" papers or books may be cited in the reference list. Information from manuscripts submitted but not yet accepted should be cited in the text as "unpublished observations" in parentheses. Personal communications should be listed in the text in parentheses. Published abstracts must not be used as references. Use of a large number of abstracts or non peer-reviewed articles in the reference section will be grounds for rejection of the submission without review.

Examples of references

Journal article:

Palmer GS, Dennis SC, Noakes TD, Hawley JA. Assessment of the reproducibility of performance testing on an air-braked cycle ergometer. *Int J Sports Med* 1996; 17: 293-298

Complete book:

Dingle JT (ed). *Lysosomes*. New York: American Elsevier, 1972: 65

Chapter of a book:

Zancetti A, Baccelli G, Guazzi M, Mancina G. The effect of sleep on experimental hypertension. In: Onesti G, Kim KE, Moyer JH (eds). *Hypertension: Mechanisms and Management*. New York: Grune & Stratton, 1973: 133-140

Figures: Figures, illustrations, or half-tones should be used when findings are best visually communicated. Figures should be numbered in Arabic numerals in the sequence as they appear in the text. Each figure should be accompanied on a separate sheet by a suitable short and concise legend. Abbreviations used in the figure must be explained in the legend. Figures should be labeled with the name of the first author and the figure number on the top left-hand corner of the reverse side of the figure with a soft pencil. Reference to the figure should be made in the text.

Figures, illustrations or half-tones must be submitted that are clear, black and white, on glossy paper and must be sharp, high-contrast and suitable for reproduction also after

reduction in size. Uniform typographical setup (font style & size, line thickness) of all figures in a paper is highly desirable.

Color figures, illustrations or half-tones will not be published unless the author requires color in the publication. In this case the author will be charged with the additional cost of printing. The use of photographs or equipment and experimental subjects should be avoided. Good line drawings are more informative.

Tables: Tables should be used to communicate information that is hard to present visually. Results whose interpretation is more easily comprehended by knowing the means and SEM (or SD) may be presented in a table(s). Tables should be self-explanatory and bear a short title. Table legends should be typed on the same sheet as the table as a header. A footnote to the table should explain all abbreviations used in the table.

Submitting the manuscript

- All manuscripts from the Western hemisphere (United States, Canada, South America) and from Pacific Ocean countries (Australia, Japan, New Zealand and Taiwan) should be addressed to: W. M. Sherman, PhD, HPER/Larkins Hall, The Ohio State University, 337 W 17th Avenue, Columbus, OH, 43210-1284, USA, e-mail: ijsm@osu.edu.
- Manuscripts from all other countries should be submitted to the European office journal secretary: Mrs. Louise Lehnen, An der Eiche 29, D-53937 Schleiden, Germany, e-mail: lehnen@online.de. Do **not** send submissions via express mail to this German address.

Electronic Manuscripts

Whenever possible, accepted manuscripts should be made available electronically. Please send diskettes to the publisher's address which is provided in the letter of acceptance. Widespread text processors should be used and the operating system, programme and version numbers should be indicated on the diskette. Please save your file in the standard format of your text processor and in one or several exchange format/s (for example, *.txt, *.rtf). If possible, the "endnote" function of the text processor should be used for the management of references. Figure legends and tables should be listed at the end of the document.

Please save figures as separate files. They should not be integrated into the text document. The following graphic file formats are preferred:

- For coloured and black-and-white bitmaps: *.eps, *.tif, *.jpg, *.wmf (resolution: 300 dpi).
- For diagrams and line drawings: *.eps (resolution: 800 dpi).

In addition to the electronic files, four paper versions of both text and figures must be submitted. In case of doubt, the paper version is given the higher priority.

Please provide a signed declaration that the paper and electronic versions are identical.

Galley proofs and proof-reading

Galley proofs will be sent to the corresponding author for proof reading. Proof reading is for typesetting errors only. At this stage the manuscript cannot be changed. The galley proofs should be returned to the appropriate address within 48 hours so the publication of the submission is not delayed.

Page charge

Together with the galley proofs, if the manuscript is more than three printed pages, the corresponding author will be asked by the publisher to submit a check or purchase order to pay the cost of publication. Up to three printed pages of publication are without charge to the corresponding author. Each printed page beginning with the fourth printed page will carry a page charge of € 160.-- (including 16% VAT).

Reprints

The authors will receive 25 reprints free of charge. An order form for reprints will be sent to the authors enabling further reprints to be ordered at prices indicated on materials contained with the galley proofs.

Appendix B

Permission Letter

San José State
UNIVERSITY

**College of Applied
Sciences and Arts**

**Department of Human
Performance**

One Washington Square
San José, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

Spring, 2003

Graduate Studies and Research
San Jose State University
One Washington Square
San Jose, CA 95192-0025

Dear Human Subjects Institutional Review Board,

I grant Kevin Robell ATC permission to interview the members of the baseball team at _____ to conduct the master's thesis research study entitled "The Effects of Field Position on The Occurrence Of Wrist Injury In Collegiate Baseball Athletes". Any questions regarding this issue can be directed to me at _____.

Sincerely,

Director of Athletics

Appendix C

Occurrence of Baseball Related Wrist Injury Interview Questionnaire

Subject Identification Code _____

Age _____

Year of Eligibility

- Yr1 ☐ Fresh Yr5 ☐ Redshirt
 Yr2 ☐ Soph Yr6 ☐ Med Redshirt
 Yr3 ☐ Jr Yr7 ☐ Transfer
 Yr4 ☐ Senior

Primary Field Position--

- PFP1 ☐ OF PFP3 ☐ C PFP5 ☐ 3B
 PFP2 ☐ MI PFP4 ☐ 1B

Item 1

Have you ever sustained a wrist injury during your baseball career? (Note: It does not have to have occurred at current institution)

- 1a ☐ Yes 1b ☐ No

Item 2

Did this injury occur during a practice or a game?

- 2a ☐ Practice 2b ☐ Game

Item 3

When in your career did this injury occur?

- 3a ☐ Little League 3c ☐ College
 3b ☐ High School 3d _____ years ago

Item 4

What type of field activity were you doing when you sustained this injury?

- 4a ☐ Sliding into a base 4d ☐ Impact w/ player
 4b ☐ Swinging a bat 4e ☐ Impact w/ ball
 4c ☐ Contact w/ wall 4f ☐ Diving for ball
 4g ☐ Other

What position were you playing?

4h _____

Item 5

On your own hand can you point to the injured area?

- 5a ☐ Radial dorsal zone 5d ☐ Ulnar volar zone
 5b ☐ Central dorsal zone 5e ☐ Radial volar zone
 5c ☐ Ulnar dorsal zone

Item 6

Initially who took care of the injury when it occurred?

- 6a ☐ ATC 6e ☐ Nurse 6i ☐ Other
 6b ☐ Physician 6f ☐ EMT
 6c ☐ Physical Th. 6g ☐ Phys Asst
 6d ☐ Chiropractor 6h ☐ Parent

Item 7

How long after the injury did you seek medical attention?

- 7a ☐ Immediately 7d ☐ Within 1st month
 7b ☐ Within 24 hrs 7e ☐ > 1 month
 7c ☐ Within 1st week 7f ☐ Never

Item 8

Do you remember what type of injury you sustained?

- 8a ☐ Yes 8b ☐ No

Item 9

If yes, briefly describe.

9a _____

Item 10

After sustaining the injury, did you continue to practice/play during that session?

- 10a ☐ Yes 10b ☐ No

Item 11

After sustaining the injury, approximately how many days of practice/play did you miss?

- 11a ☐ 0 - 7 days
 11b ☐ 8 - 21 days
 11c ☐ > 21 days

Item 12

Did this injury require any intervention?

- 12a ☐ Surgery 12d ☐ Splint
 12b ☐ Cast 12e ☐ Tape
 12c ☐ Brace 12f ☐ None

How long were you immobilized?

12e ☐ _____

Item 13

Approximately what percentage of games did you participate in before the injury?

- 13a ☐ 0-25% 13c ☐ 50-75%
 13b ☐ 25-50% 13d ☐ 75-100%

After the injury?

- 13e ☐ 0-25% 13g ☐ 50-75%
 13f ☐ 25-50% 13h ☐ 75-100%

Appendix D
Validation Letter

San José State
UNIVERSITY

**College of Applied
Sciences and Arts**

**Department of Human
Performance**

One Washington Square
San José, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

Spring, 2003

Dear Health Care Professional,

I am a graduate student in Athletic Training at San Jose State University and will be conducting a research study on the incidence of wrist injury in collegiate baseball athletes as it relates to field position. In lieu of accessing medical records and due to the lack of appropriate instrumentation on this topic, I have developed a questionnaire, which I plan to use as the instrument in the data collection process in this research study. This questionnaire will be administered by myself in an effort to maximize completion of the questionnaire and to facilitate the efficiency of the data collection process.

The purpose of the questionnaire is to determine the presence or occurrence of a wrist injury at some point in the career of collegiate baseball athletes. It is not meant for this instrument to serve as a tool for the diagnosis or assessment of *specific* injury sustained to the wrist.

Due to the embryonic nature of this questionnaire, it is important for a validation process to occur involving a review of the instrument by a panel of experts in the field of Sports Medicine. This validation process will enhance the power of the study by establishing the internal validity of the proposed research.

Please accept this letter as a formal invitation to serve on said panel of experts to assist in the review of the questionnaire for the of the previously described masters thesis research study. A sample questionnaire has been included for your analysis. Please offer your professional evaluation regarding the validity of the questionnaire to provide necessary information toward the assessment of the incidence or occurrence of wrist injury, noting the time in which it took to complete and any recommendations that you may have concerning the proposed instrument. Again, bear in mind that this instrument is *not* meant to evaluate or assess *specific* wrist injury, however, it is meant to serve as an apparatus to determine the occurrence of a wrist injury at some point in the career of the participant.

In closing, I want to extend my appreciation for your participation in this research study. It is greatly anticipated that the results of this study will provide a contribution to the body of knowledge in the field of Sports Medicine and the profession of Athletic Training. I look forward to receiving your response. At any time, questions regarding the validation process or the instrument itself, can be direct to myself at the following locations: (831) 601-1146, or krobell14@yahoo.com.

Sincerely,

Kevin Robell ATC
Grad. Asst. Athletic Trainer
CSU Monterey Bay

Appendix E

Anatomical Zones of the Wrist

ANATOMICAL ZONES OF THE WRIST

Dorsal view of the wrist. Includes radial (blue), central (yellow), and ulnar (red) zones.

Palmar view of the wrist. Includes radial (green) and ulnar (purple) volar zones.

These pictures were obtained from www.versailus.com and www.proliteinfo.com/anatofwrist.asp.

Appendix F

Letter of Consent

San José State
UNIVERSITY

**College of Applied
Sciences and Arts**

**Department of Human
Performance**

One Washington Square
San José, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

Spring 2003

Dear Participant,

You have been cordially invited to participate in a research study intended to investigate the effects of field position on the occurrence of wrist injury in collegiate baseball athletes, under the direction of Kevin C. Robell ATC. By answering the included interview questionnaire, it is assumed that you consent to participate in the study.

During the research study, you will be asked to answer a short interview questionnaire, administered by the investigator, which is expected to be completed to the best of your knowledge. This questionnaire is predicted to take approximately five minutes to complete. There is no anticipated or foreseeable risk involved by participating in this research study. In addition, there are no discernable direct benefits expected from participating in this research, however, the indirect benefit of reward from being of help to the research is possible.

Your participation is strictly confidential. Although the results of this research study may be published in a peer-reviewed journal, no information that could identify you will be included. Additionally, an alphanumeric code will be used to identify each participant to ensure confidentiality of all data collected. All data collected during the course of this research project will be destroyed at its completion.

Your consent is being given voluntarily. You may refuse to participate in the entire study or in any part of the study. If you choose to participate, you are free to withdraw at any time in its duration without any negative effect with your baseball program, San Jose State University, or any other participating institutions. No service of any kind, to which you are otherwise entitled, will be lost or jeopardized if you choose not to participate in the proposed study.

At the time of consent, a copy of the consent form will be given to each participant. Any questions regarding this research may be addressed to myself, or the Graduate Athletic Training Coordinator at San Jose State University, Dr. Leamor Kahanov at (408) 924-3040. For questions or complaints about this research study please contact Dr. Nabil Ibrahim, AVP of Graduate Studies at (409) 924-2427.

Sincerely,

Kevin Robell ATC
Grad. Asst. Athletic Trainer
CSU Monterey Bay
(831) 601-1146

Appendix G

Institutional Review Board Approval Letter

San José State
UNIVERSITY

**College of Applied
Sciences and Arts**

**Department of Human
Performance**

One Washington Square
San José, CA 95192-0054
Voice: 408-924-3010
Fax: 408-924-3053

To: Kevin C. Robell, ATC
3235 Gettysburg Court
Marina, CA 93933

From: Nabil Ibrahim,
AVP, Graduate Studies & Research

Date: May 1, 2003

The Human Subjects-Institutional Review Board has approved your request to use human subjects in the study entitled:

**"The Occurrence of Wrist Injury in Collegiate Baseball Athletes
by Field Position."**

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to any and all data that may be collected from the subjects. The approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Nabil Ibrahim, Ph.D. immediately. Injury includes but is not limited to bodily harm, psychological trauma, and release of potentially damaging personal information. This approval for the human subjects portion of your project is in effect for one year, and data collection beyond May 1, 2004 requires an extension request.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services that the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at (408) 924-2480.