Soccer after anterior cruciate ligament injury—an incompatible combination?

A national survey of incidence and risk factors and a 7-year follow-up of 310 players

Harald Roos[1], Marina Ornell[1], Per Gärdsell[2], L Stefan Lohmander[1] and Anders Lindstrand[1]

All players in Swedish soccer teams are required to have insurance in the same company. From the archives of the insurance company, all 3,735 injuries reported in 1986 in 188,152 Swedish soccer players were reviewed. Of these, 937 were knee injuries. All players were asked by mail to fill in a questionnaire and 83 percent replied. The patient records from the different hospitals were requested. The anterior cruciate injuries represented one third of the reported knee injuries.

The relative risk of sustaining an anterior cruciate ligament injury was increased in female players, in elite players, and in players in the forward position. The odds ratios were 1.6 (1.3–2.1), 3.3 (1.7–6.1) and 1.8 (1.4–2.5), respectively. The injuries occurred at a younger age in females than in males. 50 percent of the injured players were treated with anterior cruciate ligament surgery, predominantly as a reconstructive procedure, with use of a patellar tendon transplant. 30 (20) percent of the players with anterior cruciate ligament injury were active in soccer after 3 (7) years, compared to 80 (50) percent of an uninjured control population of soccer players. None of the elite players was active at the same level after 7 years. A comparison of anterior cruciate ligament-injured players, whether treated by surgical reconstruction or not, revealed no difference with regard to the proportion of players still playing soccer after 7 years.

[1]Department of Orthopedics, University Hospital, S–221 85 Lund, Sweden, [2]Department of Orthopedics, General Hospital, S-214 01 Malmö, Sweden. Tel +46 46-171510. Fax -130732
Submitted 93-11-26. Accepted 94-10-27

In Denmark, the yearly incidence of anterior cruciate ligament injuries has been estimated to be 3 per 10,000 inhabitants up to 50 years of age (Buhl-Nielsen 1991). In the US, some 70,000 anterior cruciate ligament reconstructions are performed each year. Anterior cruciate ligament injury is especially common in contact sports, such as American and European football (Balkfors 1982, Moretz et al. 1984, Engström et al. 1990). The treatment is controversial, with many conflicting aims, such as a wish to restore a high activity level, reduce the risk of subsequent meniscal tears and protect the knee from arthrosis. Studies on non-surgical treatment of anterior cruciate ligament injury have presented acceptable functional results, but the abandonment of contact sports like soccer is usually required (Tegner et al. 1984, Fridén et al. 1991). Primary ligament suture and extraarticular procedures for reconstruction have been disappointing with regard to the rate of return to an active life-style (Balkfors 1982, Sandberg et al. 1987).

Some studies on nonoperative versus operative treatment indicate better results after surgery (Andersson et al. 1989). Modern techniques, such as intraarticular reconstructions and augmented repair, may have improved the results (Andersson et al. 1989, Engebretsen et al. 1990). However, Engström et al. (1990) reported that only a minority of elite soccer players who sustain anterior cruciate ligament injuries return to soccer on the same level within the first year.

We analyzed incidence, risk factors, and the results of a national 7-year longitudinal study of anterior cruciate ligament injuries which occurred in organized Swedish soccer during 1 year.

Patients and methods

In Sweden, the players participating in organized soccer are all insured in the same company, Folksam. In 1986, there were 188,152 organized soccer

Table 1. Injuries in Swedish soccer, 1986

	1989 study	1993 study
Registered injuries	2960	3735
Knee injuries	670	937
Response rate, percent	62	83
Anterior cruciate ligament injuries	207	338
Answers in 1989 and 1993	179	179
7-year follow-up		310

Table 2. Anterior cruciate ligament injuries in Swedish socce, 1986

	Total number of players	Mean age	Anterior cruciate ligament injuries
Men	151,422	23	232
Elite	1,800		9
Non-elite	149,622		230
Women	36,730	19	106
Elite	450		15
Non-elite	36,280		91

players over the age of 15, 151,422 men and 36,730 women. 2,250 were classified as elite players, i.e., playing in the first or second league (Roos et al. 1994b). For the purpose of this study, we assume that most of the major injuries in the population of soccer players, such as knee injuries requiring medical attention, are reported to Folksam by the soccer clubs. According to the previous experience of the insurance company, 56 percent of the injury claims are completed by the insurance company after 1 year, 81 percent after 2 years, 86 percent after 3 years and all injuries are dealt with after 8–9 years. The records are not available in the main archive of the company until the case is closed.

In 1989, the archives of the company were searched for all soccer injuries occurring during 1986. A total of 2,960 injuries related to soccer were at this time reported and were completed for 1986, 670 of these were knee injuries. A more precise diagnosis than that specifying the injured part of the body was in most cases difficult to obtain from the injury reports. The knee-injured patients were contacted and asked to answer a questionnaire. The response rate was 62 percent. The patient records from the local hospitals were studied in order to verify the preliminary diagnosis given in the questionnaires. Only the records from the players who had answered the questionnaires could be studied, since the treating hospitals were otherwise unknown. A second search of the insurance company archives for soccer injuries occurring in 1986 was made in 1993. A total of 3,735 injuries were now registered in organized soccer for the year 1986, which was estimated to represent 98 percent of all injuries in soccer reported that year. The injury reports were studied again and now 937 knee injuries were found, which represent 25 percent of all soccer injuries reported for the year 1986 (Table 1). A second questionnaire was sent out in the beginning of 1993 to: 1) all the players who, in the first questionnaire, were found to have an anterior cruciate ligament injury (n 207), 2) the players who had not answered the first questionnaire (n 263), 3) all knee-injured players who had been added since 1989 (n 267).

The 2 questionnaires were identical and contained a modified protocol for the Lysholm knee-score (Lysholm and Gillquist 1982), and activity level according to Tegner (Tegner and Lysholm 1985). The patient's opinion concerning the total knee function was marked on a visual analogue scale. If the answers were incomplete or difficult to understand, the patients were contacted by telephone. The patient's records from the different hospitals were studied after permission from the patient. From the records, associated injuries and surgical procedures were noted.

The results were compared to the normal course in 180 soccer players on an average level described by Ekstrand et al. (1990). The 1993 activity level in 97 players, who played on the elite level in 1986, were separately studied as a comparison.

Statistics

Chi-square and odds ratios with a 95 percent confidence interval were used. The Mann-Whitney rank-sum test was used to calculate differences between various surgical methods.

Results

Risk factors and incidence. The questionnaire response rate for all knee-injured soccer players was 83 percent (778/937). The diagnosis was unknown in the 17 percent who had not answered. The data from the questionnaires and from the hospital records showed 338 recent anterior cruciate ligament injuries (232 men and 106 women), which was 43 percent of the reported knee injuries (Table 1). In 292 of the cases, the ligament injury was verified during surgery, either on arthroscopy or open surgery. In the remaining 46 knees, the diagnosis was based on the findings of the clinical examination, in the majority of the cases when the injured player met an orthope-

Table 3. Risk factors for anterior cruciate ligament injury

	Odds ratio
Female vs. male (elite)	6.9 (3.3–14–12)
Female vs. male (non-elite)	1.6 (1.3–2.1)
Female vs. male (trauma age < 20)	2.2 (1.6–3.6)
Elite vs. non-elite (male)	3.3 (1.7–6.1)
Elite vs. non-elite (female)	14 (9–21)
Forward vs. mid-fielder	1.5 (1.2–2)
Forward vs. defender	1.8 (1.4–2.5)
Mid-fielder vs. defender	not significant
Age < 20 vs. age > 20	not significant

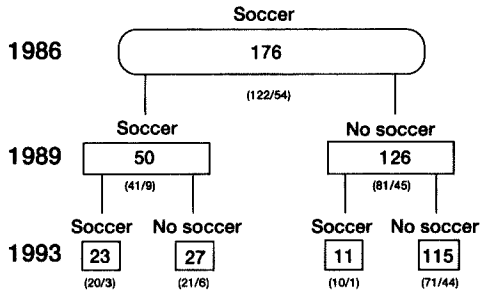

Figure 2. The changes in rate of participation in soccer during 7 years for 176 anterior cruciate ligament-injured players (men/women).

dic surgeon. In relation to the number of women in Swedish soccer (Table 2), the relative risk of anterior cruciate ligament injuries was higher for women than for men (Table 3). The female players also had a higher risk of sustaining an anterior cruciate ligament injury before the age of 20, as compared to men (Table 3, Figure 1). The relative risk of anterior cruciate ligament injuries was higher in elite soccer than in non-elite soccer for both men and women (Table 3). There was a higher risk of ligament injury for the forward players compared to defenders and mid-fielders (Table 3). It was assumed that the proportion of the different players was goal keepers 1, defenders 4, mid-fielders 4, forwards 2, according to other studies (Engström et al. 1991).

6 of the players had a previously known anterior cruciate ligament injury and 5 of these had had a previous cruciate reconstruction. These patients were excluded from the study.

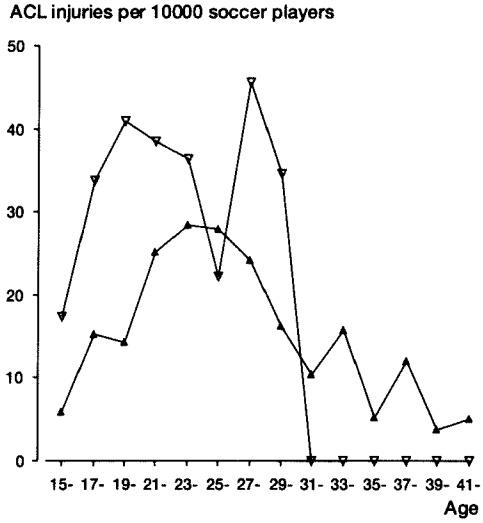

Figure 1. Age-specific incidence of anterior cruciate ligament injuries in Swedish soccer players in 1986.
▲ men, ▽ women.

Follow–up. Of the 207 ligament-injured players registered from the first questionnaire in 1989, 86 percent answered the second questionnaire, resulting in answers from both 1989 and 1993 in 176 of the anterior cruciate ligament-injured patients, 122 men and 54 women. Changes in activity level between 1989–1993 were noted (Figure 2). 11 of the players who were not active in soccer in 1989 played soccer in 1993 and, of these, 4 had been operated with a late ligament reconstruction. On the other hand, almost half of those who played soccer in 1989 had quit soccer in 1993 and according to their answers mainly because of their knee injury from 1986.

After 3 years, 70 percent of the anterior cruciate ligament-injured players had given up soccer. The probability of playing soccer 7 years after an anterior cruciate ligament injury as compared to the normal course of events in a group of uninjured soccer players (Ekstrand et al. 1990), had decreased, with an odds ratio of 2.2 (1.5–3.4) (Figure 3). To make the groups comparable, only men and non-elite players were included in the ligament-injured group when the calculation was performed.

Further, for purposes of comparison, 97 players on the elite level without a registered knee injury in 1986 were studied separately, and 31 of these were still participating in elite soccer in 1993. None of the 24 elite players with a ligament injury played soccer on the same level as before the knee injury, but 7 played soccer on a lower level. Half of the non-elite players who could resume the game played on a lower level than the pre-injury level.

Neither surgical nor nonsurgical treatment influenced the ability to return to soccer (Table 5), nor did the presence of associated injuries change the outcome in this respect (Table 4).

Surgery was performed in 93 knees within the first 2 weeks, in most cases as an arthroscopy includ-

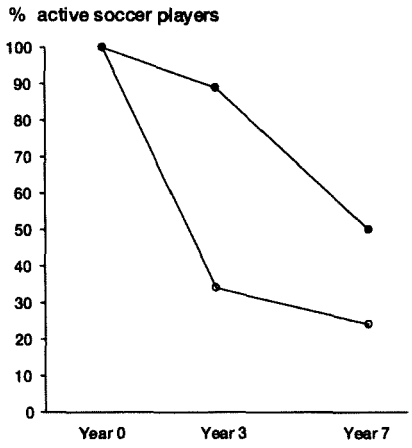

Figure 3. Percentage of still active anterior cruciate ligament-injured male soccer players 3 and 7 years after the injury, compared to the normal course in uninjured players during 7 years. The uninjured players represent the material of Ekstrand (1990), modified by the exclusion of injured players.
● uninjured players, ○ anterior cruciate ligament-injured players

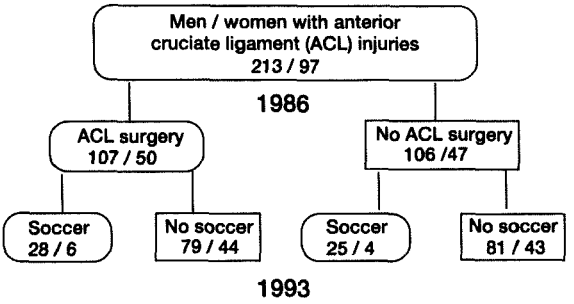

Figure 4. The influence of treatment on the number of male and female soccer players with anterior cruciate ligament injury in 1986, who were still participating in organized soccer after 7 years.

ing meniscus surgery and in 46 knees by some type of anterior cruciate ligament surgery (Table 5). A total of 474 arthroscopies in 264 of the patients were performed during the 7 years.

During the first year, anterior cruciate ligament surgery was performed in 78 knees, during the second in 21, during the third in 26 and the rest of the knees were reconstructed on a later occasion. Reconstruction with a patellar tendon graft was the commonest surgical method. There was no difference in the results after early surgery, as compared to the procedures performed later (Table 5). 5 methods for reconstruction were used (Table 5). The numbers for each method were too small to analyze statistically. 42 percent of the players were operated on at a hos-

Table 4. Types of anterior cruciate injuries

	n	Surgery[a]	Soccer 1993[b]	Exc.–good (%)[c]	VAS (mm)[d]
Partial	18	0	6	72	69
Isolated	130	61	22	37	63
Combined with meniscus and medial collateral ligament injuries	150	91	35	39	60
Combined with chondral injuries	12	5	0	42	65

[a]Number of players treated with anterior cruciate surgery
[b]Number of players participating in organized soccer in 1993
[c]Percentage of patients with 84–100 points on the Lysholm score
[d]Mean value on a 100 mm visual analogue scale

Table 5. Results of the treatment of anterior cruciate ligament injuries

	n	0–2 w[a]	Soccer 1993[b]	Exc.–good (%)[c]	VAS (mm)[d]
No surgery	153		30	37	60
Primary suture	22	22	3	26	61
Augmentation suture	14	14	4	69	80
Reconstruction	121	10	26	45	64
Patellar tendon	79	8	16	44	64
Fascia lata strip	11	0	5	45	57
Retinaculum + patellar tendon	9	2	4	90	78
Semitendinosus	7	1	0	33	72
Synthetic graft	15	5	1	28	61

[a] Operated within the first two weeks after the initial trauma
[b–d] See Table 4.

pital with a documented interest in knee ligament surgery. However, there was no difference in outcome between these knee units and other hospitals. The player's opinion about the reason for giving up soccer was in 90 percent of cases the knee injury, independent of subsequent treatment. Age at time of trauma did not influence the rate of return to soccer.

A subjective knee-score with written questions according to Lysholm resulted in 43 percent excellent or good results (100–84 points) among the operated players and 36 percent among the nonoperated after 7 years (Table 5), with no significant difference. The activity level according to the Tegner scale was, by definition, 9–10 at entry into the study in 1986 and the mean level after 7 years was 7. The 100 mm visual analogue scale value for the patients' opinion of the total knee function scale showed no difference between operated and nonoperated individuals (Table 4).

Discussion

Despite the problems associated with questionnaire studies, we considered it as an acceptable method for the study of a cohort of this size. The information provided by the questionnaires was confirmed by both of the injury reports in the insurance company and hospital records. The true proportion of knee injuries is probably lower, since it is possible that more players with anterior cruciate ligament injuries than players with uncomplicated injuries have been reported to the insurance company or have answered the questionnaire. This might explain why our results do not correspond to other studies where knee injuries represent 12–20 percent (Ekstrand et al. 1983, Keller et al. 1987, Buhl-Nielsen and Yde 1989).

The true incidence of anterior cruciate ligament injuries in soccer will probably never be determined, since a number of patients with this injury never seek medical attention, and it is not always possible to make a correct diagnosis on clinical examination (Fridén 1993). Our study, like others, found female soccer players run a higher risk of cruciate ligament injuries than males (Engström et al. 1991, Roos et al. 1994a). The reasons for the high risk of anterior cruciate ligament injuries among young soccer-playing females are thought to include insufficient muscular protection or a lack of physical fitness (Haycook and Gilette 1976). In conformity with an earlier study of soccer injuries (Buhl-Nielsen and Yde 1989), we found a higher relative risk of injuries among the elite players, than in other previous studies (Ekstrand et al. 1983, Engström et al. 1991). The main reason is probably the higher intensity of soccer on the elite level, and to some extent the better medical attention in elite clubs.

After 7 years, about 1/4 of the players with an anterior cruciate ligament injury were active in soccer. In most cases, the decrease in activity level was not desired. About half of the patients were treated by anterior cruciate ligament surgery, and of these, about 20 percent returned to play soccer at the same level. The same proportion was found in the non–operatively-treated group of patients. It could be argued that there was a selection of the patients with the most severe instability or most serious associated injuries to the operated group. This could not be confirmed in our study. It was not possible to draw any conclusions concerning the overall benefits in activity level after the different modes of treatment. However, more than 1/2 of the players had persistent problems with the injured knee after 7 years, according to both the Lysholm score and the visual analogue scale. Neither the activity level nor the subjective complaints differed between operated and nonoperated individuals.

As expected, most reconstructions were performed with a patellar tendon graft. Most repairs performed within the first 2 weeks were nonaugmented, which could explain the low number of players who were able to resume soccer in that group (Palmer 1938, Balkfors 1982, Sandberg et al. 1987). However, there was no difference in the number who resumed soccer and the type of surgical method that was used. In a randomized study on acute treatment of anterior cruciate ligament injuries (Andersson et al. 1989), the patients who were not operated on and the patients who underwent nonaugmented repair showed the same rate of return to competitive sports (17–20 percent), which corresponds to our experience. In contrast to our findings, patients with augmented repair have been shown to return to competitive sports in more than 50 percent of cases (Andersson et al. 1989, Engebretsen et al. 1990). However, none of the latter studies clearly demonstrates that the surgery makes possible a return to contact sports like soccer. We find that anterior cruciate ligament-injured players have twice the attrition rate over a period of 7 years, compared to earlier results (Ekstrand et al. 1990). Further, in a knee-injured group, the major attrition occurs in connection with the injury, and already after 3 years about 70 percent have given up soccer (Figure 3). None of the ligament-injured elite players participated in soccer at the pre-injury level after 7 years, compared to 30 percent in a normal control group of elite players. It

therefore seems that current methods for anterior cruciate ligament reconstruction may not be satisfactory for patients with high activity demands.

Our conclusion agrees with that of a recent study of elite soccer players with an anterior cruciate ligament tear (Engström et al. 1990). In our study, the players were treated in many hospitals, most of which lacked subspecialty units dealing with knee ligament surgery. However, no certain differences in the outcome of the treatment were seen between the patients treated in surgical units with a special interest in knee ligaments, as compared to ordinary hospitals.

Surprisingly, about 20 percent of the anterior cruciate ligament-injured players were able to continue playing soccer without surgical treatment. However, many investigators believe there is a risk of future joint problems with functional limitations, secondary lesions and development of arthrosis if intensive sports activities are continued after a nonoperative treatment of an anterior cruciate ligament injury (Kannus and Järvinen 1987, Neyret et al. 1993). Accordingly, the prevalence of knee arthrosis in former male soccer players is greater than in a control population (Roos et al. 1994b)

Acknowledgements

The assistance of the staff at the Folksam insurance company, especially Lars–Inge Svensson and Sengul Idegran, is greatly appreciated. This study was supported by grants from the Swedish Sports Confederation (Sports Research Council), the Swedish Medical Research Council, Zoéga Foundation, Stiftelsen för bistånd åt vanföra i Skåne, Österlund Foundation and the Medical Faculty of Lund University.

References

Andersson C, Odensten M, Good L, Gillquist J. Surgical or non-surgical treatment of acute rupture of the anterior cruciate ligament. J Bone Joint Surg (Am) 1989; 71: 965–74.

Balkfors B. The course of knee ligament injuries. Thesis, University of Lund, Lund, Sweden, Acta Orthop Scand (Suppl 198), 1982.

Buhl–Nielsen A. The epidemiology of anterior cruciate injuries in athletes. Acta Orthop Scand (Suppl 243) 1991; 62: 13.

Buhl-Nielsen A, Yde J. Epidemiology and traumatology of injuries in soccer. Am J Sports Med 1989; 17: 803–7.

Ekstrand J, Gillquist J, Möller M. Incidence of soccer injuries and their relation to training and success. Am J Sports Med 1983; 11: 63–7.

Ekstrand J, Roos H, Tropp H. Normal course of events amongst Swedish soccer players: an 8-year follow-up study. Br J Sports Med 1990; 24: 117–9.

Engebretsen L, Benum P, Fasting O, Mølster A, Strand T. A prospective randomized study of three surgical techniques for treatment of acute ruptures of the anterior cruciate ligament. Am J Sports Med 1990; 18: 585–90.

Engström B, Forssblad M, Johansson C, Törnkvist H. Does a major knee injury definitely sideline an elite soccer player? Am J Sports Med 1990; 18: 101–5.

Engström B, Johansson C, Törnkvist H. Soccer injuries among elite female players. Am J Sports Med 1991; 19: 372–5.

Fridén T. The injured anterior cruciate ligament. Thesis, University of Lund, Lund, Sweden 1993.

Fridén T, Zätterström R, Lindstrand A, Moritz U. Anterior cruciate-insufficient knees treated with physiotherapy. A three-year follow-up study of patients with late diagnosis. Clin Orthop 1991; 263: 190–9.

Haycook C E, Gilette J V. Susceptibility of women athletes to injury. JAMA 1976; 236: 163–5.

Kannus P, Järvinen M. Conservatively treated tears of the anterior cruciate ligament. J Bone Joint Surg (Am) 1987; 69: 1007–12.

Keller C S, Noyes F R, Buncher R C. The medical aspects of soccer injury epidemiology. Am J Sports Med 1987; 15: 230–7.

Lysholm J, Gillquist J. Evaluation of knee ligament surgery with special emphasis on use of a scoring scale. Am J Sports Med 1982; 10: 150–4.

Moretz A, Harlan S, Goodrich J et al. Long-term follow-up of knee injuries in high school football players. Am J Sports Med 1984; 12: 298–300.

Neyret P, Donell S-T, Dejour H. Results of partial meniscectomy related to the state of the anterior cruciate ligament. Review at 25 to 35 years. J Bone Joint Surg (Br) 1993; 75: 36–40.

Palmer I. On the injuries to the ligaments of the knee joint. Acta Chir Scand (Suppl 53) 1938; 71.

Roos H, Adalberth T, Dahlberg L, Lohmander L S. Posttraumatic osteoarthrosis of the knee, disease progress after injury to the cruciate ligament and meniscus. Trans Orthop Res Soc 1994a; 19: 218.

Roos H, Lindberg H, Gärdsell P, Lohmander L S, Wingstrand H. The prevalence of gonarthrosis in former soccer players and its relation to meniscectomy. Am J Sports Med 1994b; 22: 219–22.

Sandberg R, Balkfors B, Nilsson B. Operative versus nonoperative treatment of recent injuries to the ligaments of the knee. A prospective randomized study. J Bone Joint Surg (Am) 1987; 69: 1120–16.

Tegner Y, Lysholm J. Rating system in the evaluation of knee ligament injuries. Clin Orthop 1985; 198: 43–9.

Tegner Y, Lysholm J, Gillquist J, Öberg B. Two-year follow-up of conservative treatment of knee ligament injuries. Acta Orthop Scand 1984; 55: 176–80.