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# Lumbar Disorders of Judo Players

## 柔道選手の腰部障害

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### ●Key words

Judo player : Lumbar Disorders : Spondylolysis

柔道選手, 腰部障害, 脊椎分離

### ●Abstract

The purpose of this work is to study lumbar disorders, and their relationships with spondylolysis and spondylolisthesis, in highly trained Judo players. From 1991 to 1993, the follow-up survey of Judo players was carried out with or without lumbar disorders. And their X-ray findings were evaluated of spondylolysis and spondylolisthesis. Judo players showed high incidence of spondylolysis (33%). It suggests that spondylolysis results from stress reaction of the pars interarticularis in growth. Through this study, another spondylolysis was not occurred nor spondylolisthesis were developed. It suggests that well-trained trunk muscles prevent the development of spondylolisthesis.

### ●要旨

この研究は柔道選手の腰部障害について検討し, 柔道選手の脊椎分離症および分離すべり症との関連を解明する目的で行った。対象は実業団男子柔道選手21名とし, その腰部障害についてアンケート調査, 直接検診, レントゲン検査を行った。その結果, 21名の柔道選手のうち7名(33%)に脊椎分離を認めた。柔道選手における高頻度の脊椎分離の発生原因としては成長期における疲労骨折が考えられた。対象とした実業団柔道選手を経年的に調査したが, 新たな分離の発生や分離すべりの増悪等はなく, その予防因子としては強力な体幹筋力が考えられた。

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## Introduction

Judo is one of traditional martial arts in Japan, and that age bracket is very wide. Almost Judo players began to practice Judo in their growth.

From 1991 to 1993, the follow-up survey of Judo players was carried out with or without lombar disorders. And their X-ray findings were evaluated of spondylolysis and spondylolisthesis.

## Materials and Methods

Subjects of our study were twenty one Judo players. They were between 19 and 33 years old. Average age was 26.3 years old. They began to practice Judo at about ten years old, and have been training for six to twenty five years. Average Judo experience was thirteen years. Their average height was 178 cm, average weight was 94.5 kg. They were training for three hours a day and six days a week.

All of the subjects were checked in 1991, 1992 and 1993 at Miyazaki Medical College Hospital. Lum-

bar spine X-ray films including AP, lateral, oblique, flexion and extension postures were taken on 21 Judo players. And trunk muscle powers were examined by KIN-COM machine (Fig. 1).

## Results

Nineteen Judo players of twenty one had episodes of low back pain and six had been suffering from lumbago during the period of this study. But no one developed neurological deficit.

X-ray films proved that seven of all subjects showed spondylolysis and three of seven showed spondylolytic spondylolisthesis. No one had degenerative spondylolisthesis. Two cases showed spondylolytic spondylolisthesis in the fourth lumbar vertebra, one case showed in the fifth lumbar vertebra. Four cases showed spondylolysis in the fifth vertebra (Table 1).

All cases were pointed out spondylolysis or spondylolisthesis on their X-ray films in 1991. But through this study, another spondylolysis did not occurred nor spondylolisthesis were developed.

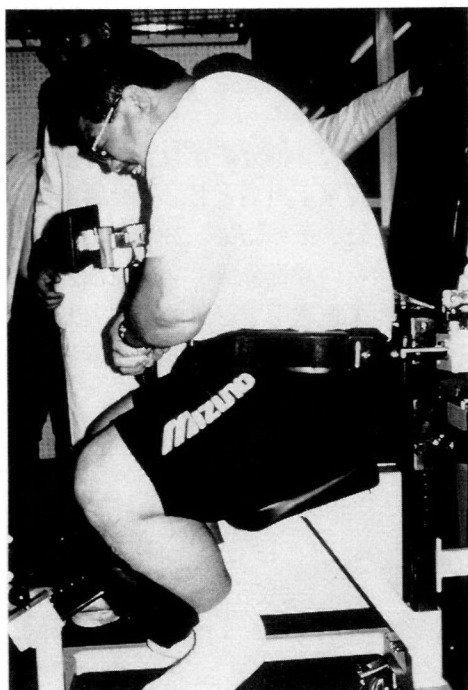


Fig. 1 : Muscle Power Test by KIN-COM

This is flexion power test of trunk. His pelvis and crura were fixed for his maximum performance of trunk flexion. Strength was evaluated by isometric contraction at zero degree of lumbar spine.

Table 1 : Subjects with spondylolysis

Case	Age	Experience ( yr. )	X-ray findings
1.	30	20	L4 spondylolytic spondylolisthesis
2.	33	25	L4 spondylolytic spondylolisthesis
3.	24	12	L5 spondylolytic spondylolisthesis
4.	28	18	L5 spondylolysis
5.	28	19	L5 spondylolysis
6.	25	13	L5 spondylolysis
7.	23	12	L5 spondylolysis

Maximum flexion and extension power of trunk was evaluated (Fig. 2). There was not significant difference between Judo players with spondylolysis and without it. There was statistical difference between Judo players and normal controls in lumbar extension.

## Discussion

Top level Judo players in Japan began to practice Judo in their growth, so sports disorders in growth

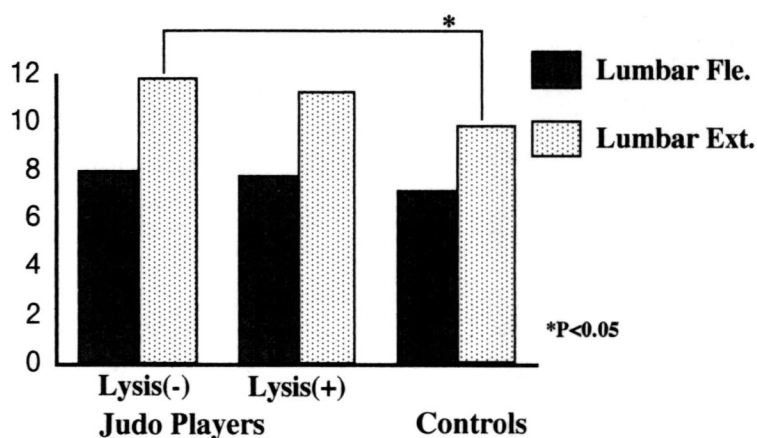


Fig. 2 : Strength of Trunk

Lumbar extension power is stronger than lumbar flexion power in every group. There is no significant difference between Judo players with spondylolysis and without it. In lumbar extension power, there is a significance between Judo players without spondylolysis and normal control.

spurt occurred frequently. Judo is a combative sports, and Judo players have repeated movement of extension to flexion of the trunk with heavy loads on their low back.

We experimented with a cause of spondylolysis

using a three dimensional finite element method. The simulated loads were applied to the surface on the superior and the inferior facet joint vertically (Fig. 3). There were heavy stress at the pars interarticularis. It suggests that stress reaction of the pars interarticularis leads spondylolysis.

Technique of Judo, especially in throwing technique, needs lumbar hyper-extension to hyper-flexion with rotation (Fig. 4). This motion is so overloaded to the facet joint, that spondylolysis occurs frequently in Judo players.

The incidence rate of spondylolysis of our subjects was 33%. Ichikawa reported high incidence of spondylolysis in Judo players of 29.2% and Yamaji reported 20.2% of spondylolysis in college Judo players. It is considered that high incidence of spondylolysis in Judo players results from stress fracture in school boy age.

Another spondylolisthesis was not occurred nor developed during the period our study. It is suspected that well-trained trunk muscles prevent the development of spondylolisthesis.

Trunk muscle power tested by KIN-COM machine proved that Judo player without spondylolysis has stronger trunk extension power than normal control. It is thought that strong trunk extension power is one of characteristics in Judo players.

It is reported that trunk muscle strength of patient with spondylolysis is inferior to it of normal without spondylolysis. But Judo players with spondylolysis had equal strength in lumbar flexion and

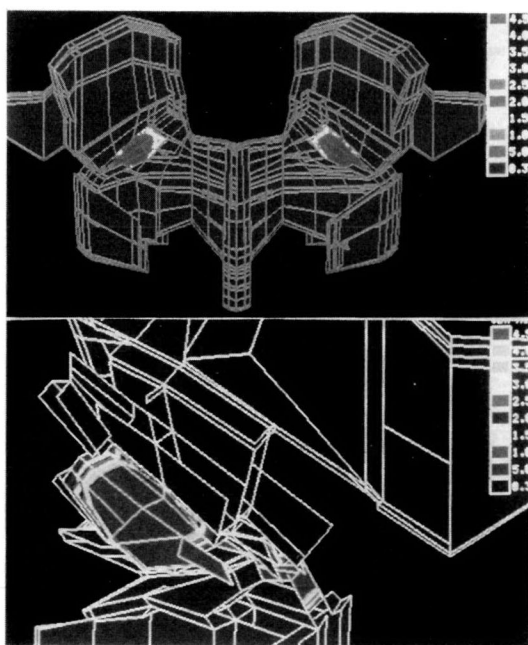
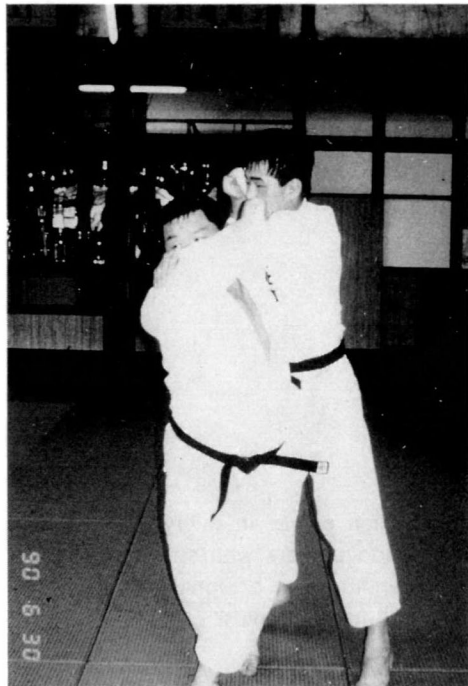


Fig. 3 : Three Dimensional Finite Element Model

The simulated loads (arrows) were applied to the surface on the superior and the inferior facet joints vertically.





**Fig. 4 : Judo play**

Technique of Judo, especially in throwing technique, needs lumbar hyper-extension to hyper-flexion with rotation. This motion proved lumbar hyper-extension with left lumbar rotation.

extension to Judo players without it. It is expected that strong trunk muscle power and excellent lumbar extension/flexion ratio prevent low back pain on Judo player with spondylolysis.

It is necessary to observe further muscle weakness after retirement of Judo. We are going to carry out follow up survey of retired Judo players.

### Conclusion

1. Judo players showed high incidence of spondylolysis (33%).  
It suggests that spondylolysis results from stress reaction of the pars interarticularis in growth.
2. Through this study, another spondylolysis was not occurred nor developed. It suggests that well-trained trunk muscles prevent the development of spondylolisthesis.

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# The Difference of Hop Biomechanics between Normals and Patients Who Have Deficiency in Anterior Cruciate Ligament

健常者と前十字靱帯断裂者のホップバイオメカニクスの相違

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## ●Key words

Hop : Anterior cruciate ligament : Biomechanics

ホップ, 前十字靱帯, バイオメカニクス

## ●Abstract

The purpose of this study was to investigate the difference in biomechanics of hopping between normals and patients who had deficiency in anterior cruciate ligament (ACL). Nine male chronic ACL-deficient patients, 26-45 years old, and 7 male normal subjects, 21-38 years old, were studied in a gait laboratory performing single legged double-hop. All subjects performed double-hop for their maximum distance with single leg. The hop test included hopping onto and off of force platform using one leg. Data of the hip, knee, and ankle were obtained bilaterally using a 3-dimensional video-based optoelectronic system for motion analysis (CFTC, computerized functional testing corporation) and a force platform for measurement of 3-D ground reaction force.

In the results from all subjects, two mechanisms of hopping were identified based on the pattern of external flexion moment about the knee. First pattern (pattern 1) showed a smooth convex curve and second pattern (pattern 2) showed a sudden decrease curve in external knee flexion moment just at maximum knee flexion. The majority of patients showed pattern 2, which produced lower loads at the knee compared with pattern 1.

Significant differences between normals and patients were found in the maximum eccentric knee power just after landing and knee angular impulse. Patients tended to use 65-70% of normal knee power and 70% of normal knee angular impulse. Patients with ACL rupture tended to reduce contraction of quadriceps during hopping.

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## ●要旨

本研究の目的は健常者と前十字靭帯（ACL）断裂者のホップバイオメカニクスの相違を検討することである。対象は陳旧性 ACL 損傷者男性 9 名（年齢 26—45 才）と健常男性 7 名（年齢 21—38 才）であった。被検者は最大距離をめざした連続 2 回ホップを片足ずつ行った。つまり最初のホップは床反力板への着地、次にここからの飛躍でこれらを一連の動作として施行した。赤外線発光ダイオードを用いた 3 次元動作解析装置（CFTC）と 3 次元床反力板により下肢の生体力学情報を集積し解析した。統計解析には student-t test を用い  $P < 0.05$  を有意差とした。結果は、床反力板での立脚時の外的膝屈曲モーメント曲線（内的四頭筋モーメント）に両群間に差がみられた。つまり健常者の多くは滑らかな凸カーブで最大値も大きいのに反し、ACL 損傷者の多くは立脚中期でのカーブの急な落込みや波状パターンを示し最大値も小さかった。また ACL 断裂者では着地直後の遠心性膝パワーと立脚時の膝仕事量も有意に小さかった。以上より ACL 断裂者はホップ動作で四頭筋作用を減少させ、脛骨の大腿骨に対する過度な前方変位を防御する動的適応を示していると考ええる。

The functional changes of the lower extremity that could occur in patients who had rupture of anterior cruciate ligament (ACL) have been undefined, especially during sports activities. Functional test in high demand activities could provide useful knowledge of optimum management of patients who should continue sports activities after ACL rupture.

Several investigators have studied the locomotor change of patients after ACL rupture<sup>3), 5), 6), 8)</sup> to identify the functional disability of ACL-deficient pa-

tients. However, there were few reports studying biomechanical change in hopping of patients who had ACL rupture. The assumption of this study was that the functional changes of lower extremity could occur to prevent abnormal displacement of tibia onto femur in ACL deficient patients. Therefore, the biomechanical study about strenuous activities could provide the strategy in management of ACL deficient patients.

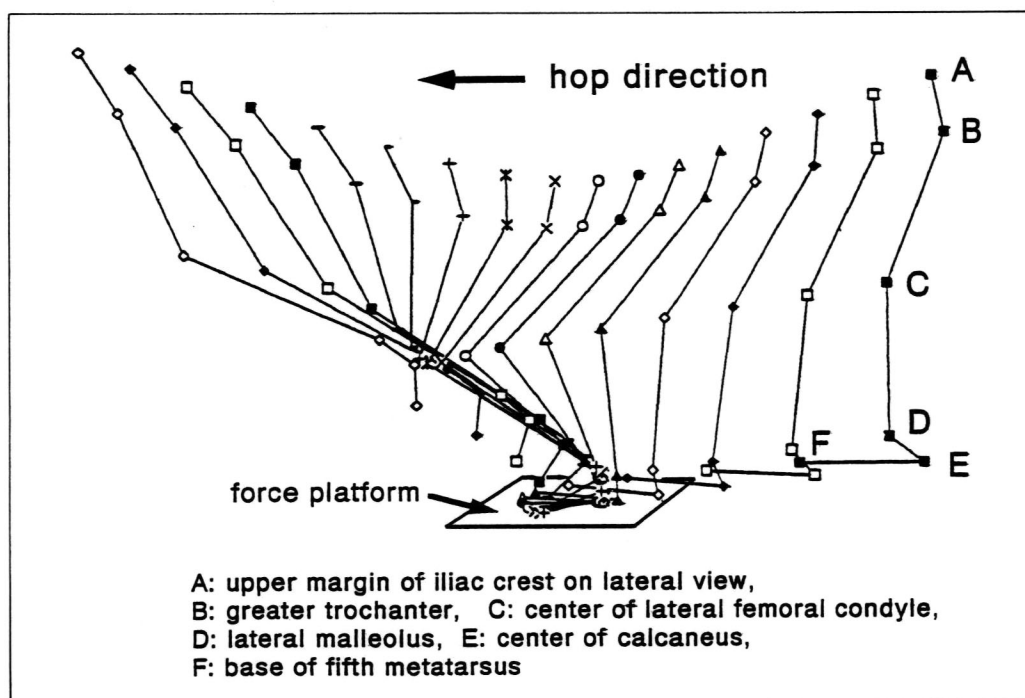


Figure 1 A stick figure of hop test. Subjects performed double hop, first was onto and second was off of a force platform with one leg for their maximum distance.

## Materials and Methods

Nine male chronic ACL-deficient patients, 26-45 years old, and 7 male normal subjects, 21-38 years old, were studied in the gait laboratory performing single legged double-hop. All patients were diagnosed as complete ACL rupture under arthroscopic examination. Patients who had less than 12 months time after injury, and showed thigh muscle weakness and significant damage to secondary restraints and/or menisci were not included in this study. All patients kept level 2<sup>2)</sup> sports activity at the time of this study. All subjects were instructed to perform stable double-hop for maximum distance on a single leg. The hop test included hopping onto and off of the force platform using one leg (Figure 1). Each subject performed two trials of hop at their maximum distances. Each trial was considered an independent event for statistical analysis. The hop mechanism and hop difference between normals and ACL deficient patients were investigated.

The instrumentation, which has been described previously by Andriacchi (CFTC, computerized functional testing corporation)<sup>1)</sup>, included a two-camera optoelectronic digitizer, lighting-emitting diodes, a multicomponent force-plate (BERTEK), and a minicomputer. Placement of light-emitting diodes on the test subjects, determination of the geometric centers of the joint, and recording of the kinetic data for the hip, knee, and ankle were performed as previously described<sup>1)</sup>. The external moments about three joints were converted into vector components along the axes of flexion-extension, abduction-adduction, and internal-external rotation for each of the joints. All moments were normalized to body weight and height.

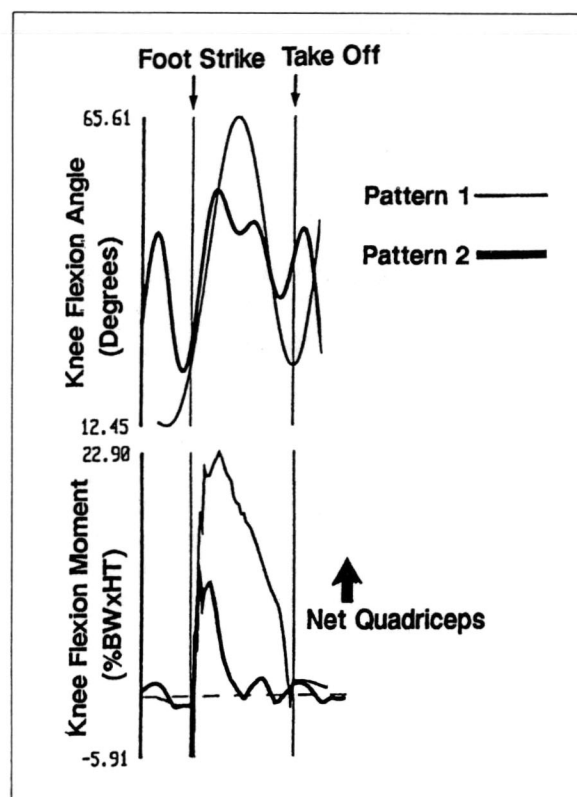
Angular impulse (total work during stance phase) and power curves of each joint were also obtained. Net internal moments of hip extensors, knee extensors, and ankle plantar flexors were defined as absolute value of measured moments in this study.

For statistical analysis, student's t-test was used and significance difference was defined at  $P < 0.05$ .

## Results

### Mechanism of Hopping

During hopping, the changes in external flexion moment about the knee that tended to flex the knee joint from ground were related to the angle of knee flexion. There were two kinds of patterns in hopping



**Figure 2** Drawing showing typical two patterns of hop test. First pattern (pattern 1 : thin line) showed a smooth convex curve and second pattern (pattern 2 : bold line) showed a sudden decrease curve in external knee flexion moment just at maximum knee flexion (upper drawing). The maximum knee flexion moment was smaller in pattern 2 compared with that in pattern 1 (lower drawing). The majority of patients showed pattern 2, which produced lower loads at the knee compared with pattern 1.

mechanism based on the curve pattern of knee flexion-extension moments. First pattern (Pattern 1) showed a smooth convex curve during stance phase of hop test. The magnitude of this moment was constantly positive during stance phase, which was balanced by a net internal moment that was produced by contraction of the quadriceps and that maintained equilibrium. On the other hand, second pattern (pattern 2) showed a sudden decrease and jagged curve pattern, which was poorly balanced by internal moment (Figure 2). 82% of hop trials in normal subjects showed pattern 1. 61% of hop trials in

Table 1 Biomechanical results of hop test depended on two patterns in knee flexion moment # 1.

	Pattern 1 (n=33)#2	Pattern 2 (n=31)#2
Max. knee flexion moment during mid-stance	15.8±3.7	12.7±2.7
Max.eccentric knee power at landing	88±35	60±21
Max. concentric knee power at take off	36±16	21±12
Max.knee anterior force	108±18	93±18
Knee angular impulse	3.7±1.1	2.5±0.8
Hop distance(%HT)	165±40	141±17

#1 : Mean and standard deviation, #2 : Number of hop trials classified into each pattern. All items have significant difference ( $p < 0.05$ ) between two patterns. unit of moment : % body weight (BW) x height (HT), power : %BW x HT x radian/second, force : %BW, impulse : %BW x HT x second, HT : cm.

affected side and 80% in unaffected side of patients showed pattern 2.

Table 1 shows biomechanical results of hop test of each pattern. The source of this data was all hop trials, which included 36 trials of patients and 28 trials of normal subjects. Pattern 2 hop showed significantly lower value than pattern 1 in maximum knee flexion moment, maximum eccentric knee power just after landing, maximum concentric knee power at take-off, maximum knee anterior force, which acted the center of the knee from posterior to anterior direction at mid-stance, knee angular impulse (total work), and hop distances. There was no significant difference in the value of knee flexion angle at landing between two patterns.

#### Differences between Normals and Patients

Table 2 shows the kinetic and kinematic data of hop test in normals and patients. Significant differences between each group were observed at the time just after landing and in mid-stance during hop test. Just after landing, the maximum eccentric knee power of patients and maximum medial force about knee of affected side of patients were significantly smaller than that of normal subjects. Patients tended to use 65-70% of knee power of normal subjects just after landing ( $60 \pm 24$ ,  $64 \pm 21$  compared with  $92 \pm 37$  per cent of body weight multiplied by height and radian per second). Another significant finding just after landing was observed in maximum inferior force about knee joints. The magnitude of this force in the affected side of patients was significantly smaller

than that in unaffected side of patients and in both sides of normal subjects ( $241 \pm 46$  compared with  $276 \pm 52$  and  $277 \pm 63$  per cent of body weight). There was no significant difference in the value of knee flexion angle at landing between each group. During mid-stance, maximum knee flexion moment (net quadriceps torque) of the patients was significantly smaller than that of the normal subjects ( $13.4 \pm 2.6$  in the affected knee and  $13.7 \pm 2.5$  in the unaffected knee compared with  $15.8 \pm 4.4$  per cent body weight multiplied by height). The maximum knee flexion angle during stance phase in the affected side was significantly smaller than that of the normal subjects ( $58 \pm 7$  compared with  $66 \pm 15$  degrees). Overall, the value of hop distance, hip angular impulse in the affected side, and of knee angular impulse in the both side of the patients were significantly smaller than that of normal subjects ( $135 \pm 18$  compared with  $163 \pm 45$  per cent of height,  $2.2 \pm 1.6$  compared with  $3.4 \pm 2.3$  per cent of body weight multiplied by height and second,  $2.7 \pm 0.6$ ,  $2.8 \pm 1.1$  compared with  $3.8 \pm 1.2$  per cent of body weight multiplied by height and second, respectively).

#### Discussion

Two mechanisms of hopping described in this study (Figure 2) proposed functional changes between normals and patients who had ACL-deficient knees. Pattern 1 produced high loads at the knee, and was seen in the majority of normal subjects,

Table 2 Kinetic and kinematic results of hop test of normals and ACL-deficient patients.

	Normals (n=28)	Patients	
		Unaffected (n=18)	Affected (n=18)
Max.eccentric knee power just after landing (%BWxHTxrad/sec)	92±37	60±24 <sup>*</sup>	64±21 <sup>*</sup>
Max. inferior force about knee just after landing (%BW)	277±63	276±52	241±46 <sup>**</sup>
Knee flexion angle (degrees)	20±9	23±9	24±8
Max.flexion moment about knee during stance phase(%BWxHT)	15.8±4.4	13.7±2.5 <sup>*</sup>	13.4±2.6 <sup>*</sup>
Max. knee flexion angle during stance phase (degrees)	66±15	60±12	58±7 <sup>*</sup>
Double hop distance(%HT)	163±45	147±14	135±18 <sup>*</sup>
Angular impulse(%BWxHTxsec)			
Hip	3.4±2.3	3.0±1.2	2.2±1.6 <sup>**</sup>
Knee	3.8±1.2	2.8±1.1 <sup>*</sup>	2.7±0.6 <sup>*</sup>
Ankle	3.7±0.9	3.4±1.2	3.5±0.6

\* : Significant difference ( $p < 0.05$ ) from normals, \* \* : Significant difference ( $p < 0.05$ ) from normals and unaffected side of patients.

while Pattern 2 produced lower loads, and was seen in the majority of ACL deficient patients. The most important finding was that the subjects who showed Pattern 2 in knee flexion moment had lower magnitude not only in the peak value of several valuables but also in total work (angular impulse) of knee extensors (Table 1). This result suggested that the patients who had ACL rupture tended to avoid potential muscle function in the strenuous activities, and also indicated that the majority of ACL deficient patients (80% of contralateral side showed pattern 2), also developed contralateral adaptation that reduced loading at the knee.

The significantly small magnitude of eccentric knee power in both knees of patients (Table 2) indicated that patients with ACL rupture tended to avoid contraction of quadriceps at landing. This functional adaptation was also reported in gait study<sup>3)</sup>, in jumping<sup>5)</sup>, and in running<sup>4)</sup>. These findings might be protective mechanisms from abnormal anterior translation of tibia.

Significant small values in medial and inferior knee force just after landing in affected side of patients (Table 2) indicated ACL-deficient knees could adapt to decrease shear force in coronal plane and joint compression force.

In hop data described in this study, the angular

impulse about the hip of affected side was also significantly smaller than that of normals but not about the ankle (Table 2). These results were different from that of runing study for ACL deficient patients<sup>4)</sup>. This difference may be caused from the kinetic difference between hopping and running.

External knee extension moment (net hamstring moment) during hopping was absolutely small. Therefore, hop test could not be recommended for testing functional change of hamstring.

In the management of patients after ACL rupture, more flexed knee position at landing is recommended to prevent abnormal anterior translation of tibia onto femur<sup>7)</sup>, resulted in suppressing degenerative change of the knee joint.

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# Causal Factors in Four Accidental Deaths Caused by Skiing Injuries

## スキー外傷で死亡した4例—その原因因子の検討

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### ●Key words

skiing injury : head injury : death  
スキー外傷, 頭部外傷, 死亡原因

### ●Abstract

We evaluated 4 cases of accidental deaths sustained while skiing. Patients were seen at Critical Care and Emergency Center, Iwate Medical University during the winter seasons between 1987 and 1993. We analyzed causal factors related to the individual skiers, the equipment and the environment. Deaths were due to head injuries sustained by colliding with an obstacle at a high speed. The individuals were young male students of an intermediate or excellent level of fitness and were intermediate or skilled skiers. There was no problem with their equipments. Accidents in those cases occurred on fine or cloudy days with good visibility, week days, light skiing traffic and excellent snow condition, all favorable conditions for downhill skiing. Unfavorable conditions were the subjects' fatigue and the use of narrow runs with a high risk of going off the course. The rate of accidental deaths was 0.38 per million skier days, which was very low compared with that of other countries.

### ●要旨

1987年から93年に岩手医大高次救急センターに搬送されたスキー外傷により死亡した4例について臨床経過および個人, 道具, 環境因子について検討した。全例男性で平均18.8歳であった。共通点としては, ハイスピードで障害物と衝突し頭部を受傷, 学生, 中等度以上の体力, 中上級者, 晴ないし曇の視界のよい平日で空いたデレンデ, スムースな雪面での受傷が挙げられた。これらスキーには好条件と考えられる因子が死亡例発生の因子となる可能性が示唆された。悪条件としては疲労の関与, ゲレンデ幅が狭いことが挙げられた。死亡事故の発生率は, 0.38/million skier・days と概算され, 諸外国と比べはるかに少ない。

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## Introduction

With the development of high-tech skiing equipment and the improvement of skiing areas, more skiers now enjoy high-speed downhill skiing. There has been a concomitant increase in severe skiing injuries. While the analysis of severe skiing injuries and accidental deaths would help in developing improved safety measure, few such studies have been published<sup>1-7</sup>.

Iwate Prefecture is one of the most popular ski resorts in Japan. In fact in 1993, one of the World Cup circuits was held there. More than 15 million skier·days were spent at Iwate Prefecture during the ski seasons between 1987 and 1993 (Report on trends in ski visitors in Iwate Prefecture by Commerce and Trade Division, Iwate Prefecture, Japan).

The Critical Care and Emergency Center, Iwate Medical University is the main emergency hospital in this Prefecture. Cases of severe skiing injuries are sent to this hospital either directly or via another hospital. We evaluated data on four

accidental deaths due to skiing injuries treated at this hospital during the winter seasons between 1987 and 1993.

The following factors were analyzed : Individual factors including age, sex, education, skill, and presence of alcohol ; equipment factors including owner of the skis and type of binding ; and environmental factors including time of accident (year, month, day, hour, date), the terrain and snow conditions (gradient, weathers, nature of snow, snow surface), traffic on the course, width of the run, speed upon impact, and mode of injury. Data on the subject's ski equipment, on environmental factors, and circumstances were obtained from the injury report provided by the rescue team for that area. Data on individual factors were obtained from medical record at the hospital.

## Case report

We analyzed 4 cases referred from two ski areas in the Iwate Prefecture, males whose average age

Table 1 Causal factors in 4 fatal cases of head injury sustained while skiing

	Case 1	Case 2	Case 3	Case 4
Age	16	22	18	19
Sex	Male	Male	Male	Male
Family relation	Eldest son	Eldest son	—	Eldest son
Educational	High school student	University student	High school student	University student
Fitness level	Excellent	Intermediate	Excellent	Intermediate
Alcohol	No	No	No	No
Skis	His own	His own	His own	His own
Binding	Step in	Step in	Step in	Step in
Binding released	Yes	Yes	Yes	Yes
Skill	Excellent	Intermediate	Excellent	Intermediate
Date	January/89	February/90	March/91	March/93
Time	Weekday	Weekday	Weekday	Weekday
Time	11:50	8:40	16:40	15:30
Gradient	Intermediate	Intermediate	Gentle	Intermediate
Weather	Fine	Fine	Fine	Cloudy
Visibility	Good	Good	Good	Good
Surface	Smooth	Smooth	Smooth	Smooth
Snow condition	Fresh	Fresh	Wet	Icy
Traffic	Moderate.	Moderate.	Light	Light
Speed	High	High	High	High
Width of run (m)	25	30	35	30
Circumstances	While descending straight down at the right side of the course, he tried to turn to the left, but failed, and collided with a tree.	Lost control and collided with a lift tower.	While descending straight down the right side of the course, he looked aside, then collided with a tree.	He lost control while descending an icy slope and collided with a tree.

was 18.8 years, range 16 to 22 years. They were brought to the Critical Care and Emergency Center, Iwate Medical University within 2 hours after the accident. Details appear below.

**Case 1 :** This 16-year-old male high school student, an advanced skier was comatose on admission. Glasgow coma scale (GCS) was  $E_1, V_1, M_2$ , (total score : 4 points). His blood pressure was 161/89 mmHg and his pulse rate was 51 beats per minute. Respirations were shallow and rapid at 32 breaths per minute. Chest X-rays showed pneumonitis probably due to aspiration. The size of the pupils was unequal ( $R < L$ ) and the light reflex was delayed. There was bleeding with leakage of spinal fluid from the nose. X-ray films of the head showed a posterior linear skull fracture. A CT of the head revealed diffuse swelling in the brain, subarachnoid hemorrhage, brain contusion, pneumocephalus. Examination of the blood coagulation parameters showed a platelet count of  $96,000/\text{mm}^3$ , an activated partial thromboplastin time of 106.0 sec (normal : 37.1 sec.), a prothrombin time of 24.2 sec. (normal : 14.6 sec.), fibrinogen of 19.0 mg/ml, and an antithrombin III of 75.3% diagnosed as disseminated intravascular coagulation. The trachea was immediately intubated and patient was placed on a respirator. The administration of barbiturate therapy for reduction of intracranial hypertension was instituted using a thiamylal sodium. However, there was marked swelling in the brain and the brain stem reflex including the light reflex disappeared on the first day. Both the auditory brainstem response (ABR) and electroencephalography (EEG) became flat on the second day. The patient died on the 19 th hospital day.

**Case 2 :** This 22-year-old male university student, an intermediate level skier, was comatose on admission; the GCS was  $E_1, V_2, M_4$ , (total score : 7 points). His blood pressure was 138/77 mmHg and his pulse rate was 64 beats per minute. Respiration was constant at 14 breaths per minute. The light reflex was rapid, and pupillary inequality ( $R < L$ ) was present. X-ray films of the head revealed no significant fractures, and CT of the head revealed a subarachnoid hemorrhage, and an intradural hematoma (about 50 ml) in the subcranial region of the left medial skull. There was a mid-line shift from left to right. The trachea was immediately intubated and the patient was placed on a respirator. The administration of barbiturate therapy for reduction of intracranial hypertension was instituted using a thiamylal sodium. The hematoma was removed in an emergency operation. However, the patient showed marked

swelling of the brain and the light reflex disappeared on the first hospital day. The ABR became flat on the 4 th day. A transcranial Doppler test revealed no blood flow in the brain. The patient died on the 9 th hospital day.

**Case 3 :** This 18-year-old male high school student, an advanced skier, was in cardiac and respiratory arrest on admission. A comminuted skull fracture was observed in the parietal region with resulting prolapse of the brain. Despite attempts at cardiopulmonary resuscitation the patient could not be revived, and was pronounced dead 1 hours after admission.

**Case 4 :** This 19-year-old male university student was an intermediate-level skier. On admission, his GCS was  $E_3, V_3, M_5$  (total score : 11 points). His blood pressure was 134/94 mmHg, and the pulse was 64 beats per minute. Respirations were constant at 24 breaths per minute. The light reflex was rapid and there was no pupillary inequality. Hemorrhage from the right ear with leakage of spinal fluid were noted. X-ray films of the head revealed a contusion of the bilateral frontal lobe. The intracranial pressure was controlled by the infusion of mannitol. On the first hospital day, the patient experienced a generalized chronic spasm. CT of the head revealed cerebral edema, so that tracheal intubation was carried out and barbiturate therapy was instituted. However, the patient's pupils became dilated and the light reflex was lost. The ABR became flat and he died on the 6 th hospital day.

**Conditions at the injury :** Contributory factors in the 4 cases are listed in the Table 1. Two were high school students and two were university students. Two were of excellent fitness and 2 were of intermediate fitness. Two were advanced and two were of an intermediate level of skiing competence. No alcohol was detected in their serum on admission. The accident occurred in January in one case, in February in one case and in March in 2 cases. All accidents occurred on weekdays when the ski area was not crowded. In each case the ski run was 25 to 60 m wide. The accident occurred in the morning in 1 case, around noon in 1 case, and in the evening in 2 cases. The victims all wore their own skis. Bindings were of the step-in type. At least 3 of the subjects had sufficient knowledge about adjusting the bindings. The weather was clear in 3 cases and cloudy in one case, while visibility was good in all 4 cases. In 3 cases, the gradient of the slope was intermediate (10-20 degrees), while it was gentle (about 5 degrees) in the other case. The snow surface was smooth, it was fresh in 2 cases, wet in one

case, and icy in one case. In each instance, the subjects collided with a tree in 3 cases, and a lift tower in the other case. The run in which the 3 subjects collided with a tree ranged from 25 to 40 m wide. These 3 subjects were skiing at the edge of run, then ran off the course and collided with a tree. In case 1, the course was set along the ridge. The lift tower with which case 2 collided was located at the edge of the run. A protective net was in place.

## Discussion

All four accident victims were young male skiers who collided with obstacles at a high speed, and sustained fatal injuries to the head. Findings resembled those in previous reports<sup>1-7</sup> as to age range, sex, and mechanism of injury. However, according to the statistical report on skiing injuries during the ski seasons between 1988 and 1992 in one of the ski areas reported here<sup>8</sup>, the average age was 30.5 years with only 3.8% of the injuries caused by collision with an obstacle, and about 12.5% had sustained a head injury. These findings resemble those reported in other countries<sup>9-11</sup> and in other regions of Japan (reports on ski injuries by Safety Measure Division of the Japan Ski League and by All Japan Skiing Safety Measure Conference written in Japanese).

Other common factors in the accidental death cases; male student, eldest son, and of intermediate or excellent level of physical fitness. Equipment was owned by the victim and was apparently not a casual factor. Accidents occurred on fine or cloudy weekdays with good visibility on an empty course and on a smooth surface. While these conditions make for excellent skiing, they can also be regarded as risk factors for high-speed collisions.

Fatigue may have been a contributing factor since the accidents occurred at the end of either the morning or the afternoon session in 3 of the 4 cases. A narrow run with a high risk of going off the course may also have been a contributory factor. The width of run where the 3 subjects collided with a tree ranged from 25 to 40 m, and both sides of the run were forested. Ski runs in Japan are usually constructed by deforestation. There is a great accumulation of snow on the ski runs than in the forest so that the course is elevated. Thus, once a skier runs off the course, he can collide with a tree. The energy of impact is the sum of the kinetic and the potential energy; severe and even fatal injuries are the result. In the subject who collided with the lift tower, the run (30 m) was narrow. Lift towers in Japan

are often located on the ski course with a high risk of collision.

In reviewing almost 7800 reports of all skiing injuries in these two ski areas during the ski seasons between 1987 and 1993, no accident victims died at the scene; the only fatal injuries were those reported here. The number of visitors to those two ski areas was estimated to be 11 million skier·days<sup>8</sup>; thus the rate of ski injuries was calculated to be 0.71% and the death rate was calculated to be 0.38 per million skier·days, lower than that in other countries, i. e., : 0.81 per million skier·days in Canada<sup>4</sup>, 0.25 in Australia<sup>7</sup>, and 1.71 in the USA<sup>6</sup>. The rate in Australia was underestimated since the study excluded deaths that occurred more than 24 hours after the accident.

Most of such head injuries may be prevented if the following preventive measures are taken: 1) Expansion of ski runs, elimination of obstacles, and fencing off or marking of dangerous zones. 2) Education of youths to prevent reckless speeding and encourage falling on the slope before colliding. 3) The use of helmet. Oh et al. discovered in an experimental study that a collision at a speed of about 16 km/h may result in a depressed skull fracture and therefore advocated the use of a helmet<sup>12</sup>.

## Foot notes

The GCS evaluates the patient's level of consciousness in three ways: verbal response, eye opening, and motor response. The GCS score is obtained by adding the individual scores for each of the three components. A fully oriented, alert patient would receive the maximum score of 15. A mute, flaccid patient who has no eye opening to any stimuli would receive a score of 3.

## Acknowledgments

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# Fracture of the Shaft of the Radius and Ulna Due to Entanglement of a Volar Protector During Horizontal Bar Exercise

## 鉄棒競技中に生じたプロテクター巻き込み による前腕骨骨折について

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### ●Key words

Fracture of the radius and ulna : Horizontal bar exercise : Entanglement of a volar protector  
前腕骨骨折, 鉄棒競技, プロテクターの巻き込み

### ●Abstract

Fracture of the shaft of the radius and ulna due to entanglement of a volar protector with a rod during horizontal bar exercise is an uncommon injury. We presented two cases and studied via a questionnaire the gymnastics members and analysed their answers.

The cause of this accident was mainly forceful palmar flexion of the wrist joint according to using stretched protector.

In terms of prevention of this injury, the gymnasts should pay attention to the length of the protector and the use of well-fitting protector.

### ●要旨

鉄棒競技で使用するプロテクターの巻き込みによる前腕骨骨折は、比較的稀な外傷である。私達は2例経験したので、その受傷原因を知る一助として、体操部員を対象にアンケート調査を行い分析した。

その結果主たる原因は、伸び切ったプロテクターを使用して、手関節掌屈を強制されることであった。

予防としては、競技者は常にプロテクターの長さが良く手にフィットしているか特にその長さに留意することが肝要と考えられた。

## Introduction

A volar protector is an apparatus used for the horizontal bar, flying rings, parallel bars, and uneven parallel bars in gymnastics. Its purpose is mainly to protect the hand from injuries and to facilitate grasping the bars. Demands for difficult skills have led to improvement in the protector, and subsequently the appearance of the new protector with a rod (Fig. 1). There is a trend that skilled gymnasts use volar protectors with rods, whereas unskilled gymnasts use those without rods.

We have experienced two rare cases of fractures of the shaft of the radius and ulna due to the entanglement of a volar protector during horizontal bar exercise. This report presents these two cases and discusses causes and prevention.

## Materials and Methods

We have experienced two cases of fracture of the radius and ulna due to entanglement of a volar protector with a rod during the period from 1985 to 1992.

We present these two cases, and then report the results of a related questionnaire to fifteen members of Tokai University gymnastics club (Table. 1). All members are male.

## Case Reports

### Case 1

In May 1985, a 20-year-old male who had begun

gymnastics 6 years previously was practicing the giant swing on the horizontal bar. He wore a volar protector with a rod. Suddenly, his left wrist joint was fixed due to entanglement of this protector dur-

Table 1. Questionnaire

1. Have you ever experienced entanglement of a volar protector during horizontal bar exercise?  
Which types of protector did you use then—with or without a rod?
2. What kind of exercise were you doing at the time?
3. If you experienced entanglement, what kinds of complications did you have?  
What kind of treatment did you get for them?
4. If you experienced entanglement, how many years had you practiced gymnastics until then?
5. What kind of aftereffects or sequelae did you get?
6. Which type of the protector do you use now?  
(to all members)  
A. without a rod                      B. with a rod
7. What are the merits and demerits of using a volar protector with a rod?
8. What causes and prevents the entanglement of a volar protector in your opinion?

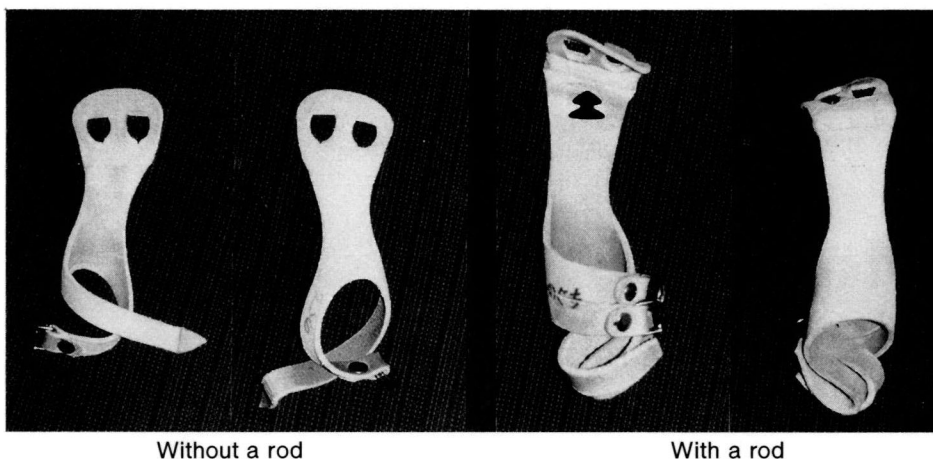


Figure 1.

ing exercise from giant swing backward : 1 / 2 turn to momentary handstand and backward swing in hang (Fig. 2-a). Then, his body was rotated, while his wrist joint was fixed in palmar flexion. He felt a severe pain and deformity of left forearm which made him visit our hospital. Plain films revealed fractures in the distal third of left radius and ulna

He was operated on with A-O narrow plates. He has approximately 5 degrees limitation of supination seven years after the operation (Fig. 3). He returned to full sports activities four years ago and works as a the junior high school teacher now.

### Case 2

In October 1989, a 17-year-old male who had be-

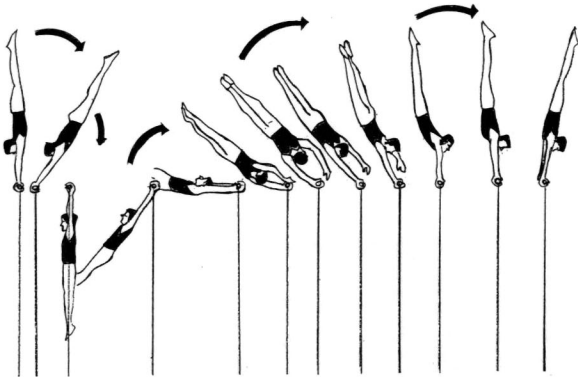


Fig. 2-a From giant swing backward : 1 / 2 turn to momentary handstand and backward swing in hang

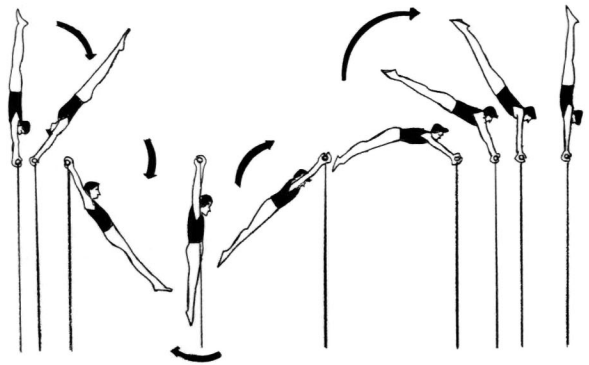


Fig. 2-d Giant swing forward

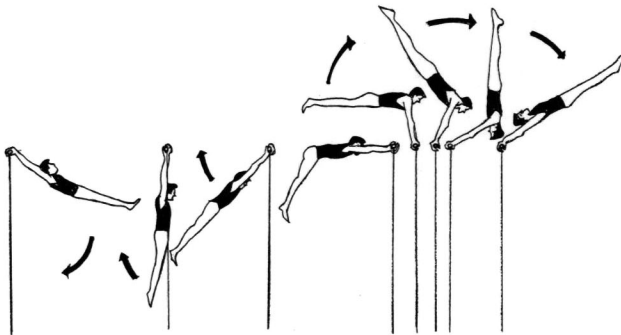


Fig. 2-b L giant swing

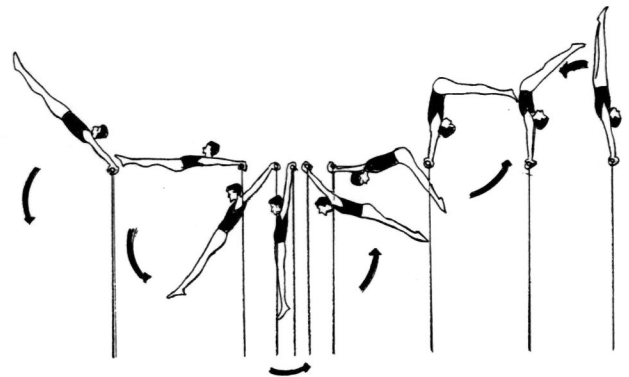


Fig. 2-e Russian giant swing

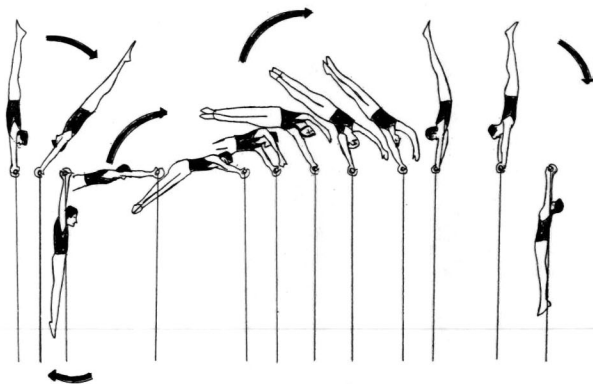


Fig. 2-c From giant swing forward : 1 / 2 turn to momentary handstand and forward swing in hang



Fig. 2-f Giant swing backward

Figure 2.



gun gymnastics at 11 years of age was training for the giant swing on the horizontal bar. His protector was caught on the bar, leading to immobilization of the left wrist in palmar flexion, while he was in the midst of L giant swing (Fig. 2-b). Only his trunk was rotated, and his left forearm was injured. Roentgenograms revealed fractures of the left radius and ulna. He underwent open reduction and internal fixation with a plate and a Kirschner wire in another hospital. Unfortunately, this fracture did not heal but developed non-union. In November 1990, he was reoperated with inlay graft using A-O plates. Two years postoperatively he has returned to

active gymnastic at Tokai University (Fig. 4).

### Results of Questionnaire study

Fifteen members of the gymnastics club of Tokai University were studied with the questionnaire. (including case 1 and excluding case 2) Average age was 19.9 years (range 18 to 23), a history of gymnastics experience varied from 5 to 15 years (mean, 9.5 years). Age at the time of beginning gymnastics was from 6 to 18 years old (mean, 10.5 years). 9 members (60%) have experienced en-

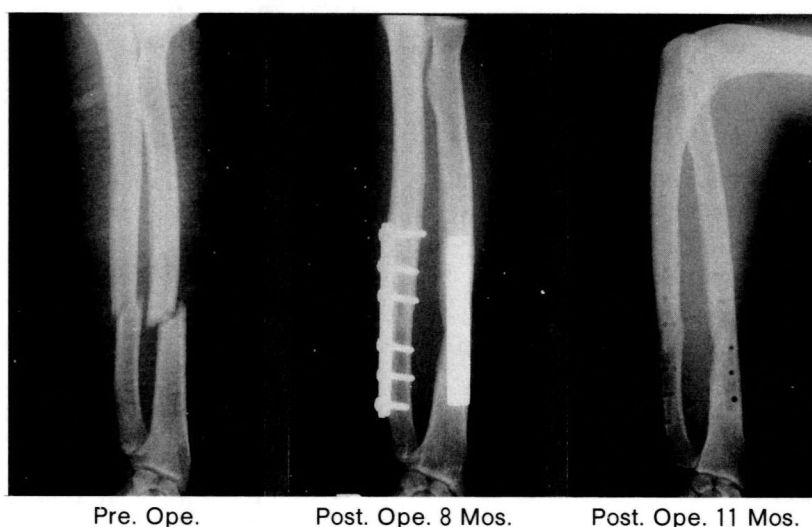


Figure 3.

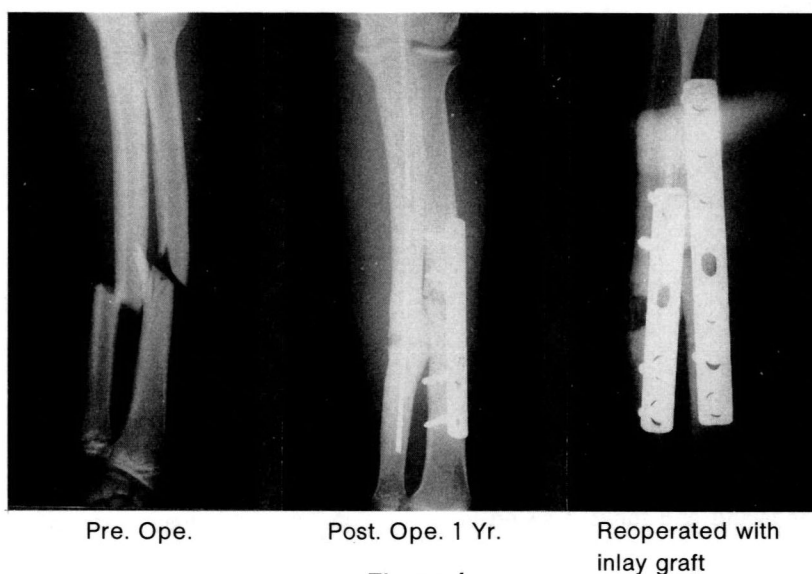


Figure 4.

tanglement of the volar protector during horizontal bar exercise (Table. 2). All gymnasts used volar protector with a rod, and had injuries of soft tissue or bone. Four out of the nine cases had fractures. Their history of gymnastics varied from 3 to 6 years (mean, 5 years). Two cases, with avulsion fractures of the 'wrist joint', were treated conservatively. The other two cases, who had fractures in the shaft of radius and ulna, were treated operatively. All cases have returned to full sports activities. Only these two cases had a little limitation of supination of forearm subsequently.

Performances of horizontal bar exercise which caused the injuries consisted of four cases of L giant swing (Fig. 2-b), two cases of giant swing forward : 1/2 turn to momentary handstand and forward swing in hang (Fig. 2-c), two cases from giant swing backward : 1/2 turn to momentary handstand and backward swing in hang (Fig. 2-a), one case from giant swing forward (Fig. 2-d).

We asked nine responders, who had experienced entanglement of a protector, the following question : What did they think were the causes of entanglement? In the majority of cases (6 cases), the cause was that they had used the protector with became lengthened due to wear and tear, and, secondly, that the individual could not turn to the position of dorsal flexion of the wrist joint (3 cases). Also they used a protector not correctly fit-

ting their hands in two cases, or grasped the bar with excessive force (2 cases). In one case the bar was thought to be 'too big'. These answers were same as other member's opinions.

## Discussion

The fractures of the radius and ulna due to entanglement of a volar protector on the horizontal bar exercise are uncommon. To our knowledge, only eleven cases have been reported to date in Japan<sup>1,4</sup>. Eight out of the eleven cases were reported in detail (Table. 3)<sup>2,3,5</sup>. Their ages ranged from 13 to 23 years (mean, 16 years). Our two cases 17 and 20 years were in the same age range. These injuries occurred 8 months to 10 years (mean, 3.4 years) since the beginning of the horizontal bar exercise. Both our two cases were 6 years. Exercise associated with these injuries were the following : two cases from giant swing forward : 1/2 turn to momentary handstand and forward swing in hang, two cases from giant swing forward, one case from Russian giant swing (Fig. 2-e), one case from giant swing backward : 1/2 turn to momentary handstand and backward swing in hang, one case from giant swing backward (Fig. 2-f).

The mechanism of these injuries was reportedly forceful palmar flexion of the wrist, which is same

Table 2. Case of Entanglement of a Volar Protector

	Age (yr)	History of gymnastics (yr)	Exercise	Fractures
Case 1	13	5	From G.S.F	Shaft of radius and ulna
2	8	3	L.G.S	Avulsion Fx of right wrist joint
3	13	8	From G.S.F	
4	18	1	G.S.F	
5	16	5	L.G.S	
6	17	6	L.G.S	Avulsion Fx of right wrist joint
7	16	3	L.G.S	
8	14	4	From G.S.B	
9	20	6	From G.S.B	Shaft of radius and ulna

From G.S.F..... From giant swing forward :  $\frac{1}{2}$  turn to momentary handstand and forward swing in hang

From G.S.B ..... From giant swing backward :  $\frac{1}{2}$  turn to momentary handstand and backward swing in hang

L.G.S..... L Giant swing

G.S.F..... Giant swing forward

Table 3. Reported Cases in Japan

	Age (yr)	History of gymnastics (yr)	Exercise	Fractures	Reported by
Case1	13	2	From G.S.F	Shaft of radius and ulna (R)* <sup>2</sup>	Ohtsuka
2	18	3	From G.S.F	Galeazzi Fx. (L)* <sup>3</sup>	Ohtsuka
3	15	1	R.G.S	Shaft of radius and ulna (R)	Ohtsuka
4	15	3	G.S.F	Shaft of radius and ulna (L) Epiphyseolysis of radius end (L)	Ohtaki
5	14	2	From G.S.B	Epiphyseolysis of radius end (R)	Ohtaki
6	15	4	?	Epiphyseolysis of ulna end (R) Styloid process of ulna (R)	Ohtaki
7	23	10	G.S.F	Shaft of radius and ulna (L)	Takao
8* <sup>1</sup>	16	5	G.S.B	Shaft of radius and ulna (L)	Takao

From G.S.F.....From giant swing forward :  $\frac{1}{2}$  turn to momentary handstand and forward swing in hang

From G.S.B.....From giant swing backward :  $\frac{1}{2}$  turn to momentary handstand and backward swing in hang

R.G.S .....Russian Giant swing

G.S.F .....Giant swing forward

G.S.B .....Giant swing backward

\*<sup>1</sup>Only this case used a volar protector without a rod.    \*<sup>2</sup>Right    \*<sup>3</sup>Left

with our cases. Concerning the types of fracture, a case of non-arrested epiphysis line had epiphyseolysis, an arrested case had a shaft fracture.

On the questionnaire, all responders indicated they used protectors with a rod. They said that the merits of those with rods were that they could grasp the bar easily, forceful grasping was not necessary, corresponding to the demands of higher grade technique, etc.. Demerits mentioned were mainly entanglement of a volar protector. They mention the causes, including assumed ones : The protector was lengthened excessively (10 cases, 75%). They could not turn to the position of dorsalflexion of wrist joint from the position of palmar flexion (8

cases, 54%). They grasped the bar with excessive force (4 cases). It did not fit to their hands (2 cases), etc. (Table.4).

To prevent these accidents, the gymnasts should pay attention to the above mentioned factors and make it a rule to check their protectors before training.

In performing the giant swing, the protector crosses the horizontal bar obliquely. Then, the protector is loosened adding to turn to delay of dorsal flexion of wrist joint. This situation is most dangerous for this accident (Fig.5).

The gymnasts should pay particular attention to exercise of L giant swing and giant swing forward (backward) :  $\frac{1}{2}$  turn to momentary handstand and forward (backward) swing in hang.

Table 4. Causes of Entanglement

1. The protector was lengthened excessively	10 cases
2. They couldn't turn to the position of dorsalflexion of the wrist joint	8 cases
3. They grasped the bar with excessive force	4 cases
4. They used a protector not correctly fitting their hands	2 cases
5. A rod was too big	2 cases
Total 15 cases	

## Conclusions

1. We reported two cases who sustained fractures of the shaft of the radius and ulna due to entanglement of a volar protector with a rod during horizontal bar exercise.

2. We studied via a questionnaire the gymnastics members of Tokai University and analysed their answers.

3. The cause of entanglement of the volar protec-

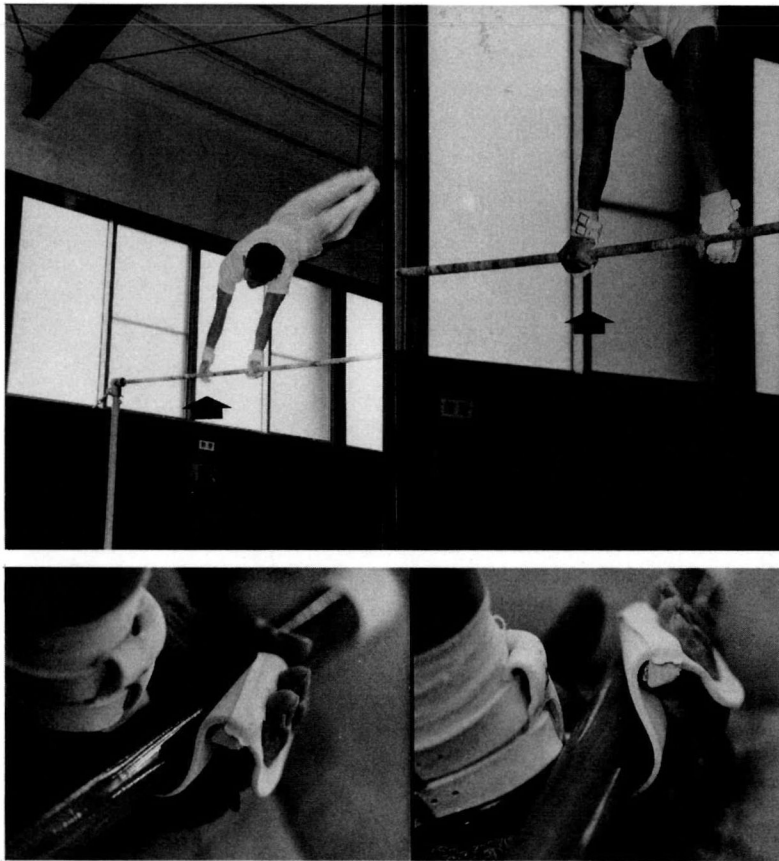


Figure 5. In performing, when the gymnasts play the giant swing, the protector crosses the horizontal bar obliquely. Then, the protector is loosened adding to turn to delay of dorsal flexion of wrist joint.

tor was mainly forceful palmar flexion of the wrist joint according to using stretched protector.

4. The gymnasts should pay particular attention to training of L giant swing, and giant swing forward (backward) : 1/2 turn to momentary handstand and forward (backward) swing in hang.

5. In terms of prevention of this injury, the gymnasts should pay attention to the length of the protector and the use of a well-fitting protector.

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# Factors Involved in Ski-related Traumatic Dislocation of the Hip

## スキーによる股関節脱臼の6例—その発生要因の検討

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### ●Key words

Skiing injury : traumatic dislocation of hip : Causal factor  
スキー外傷, 外傷性股関節脱臼, 発生要因

### ●Abstract

We evaluated factors involved in 6 cases of traumatic dislocation of the hip that occurred during skiing at the Appi Ski Resorts in the past 6 years. Five of the 6 accident victims were men. The injury was caused by a fall in 4 cases and by a collision with a tree in 2 cases. Of the 4 cases of injury related to a fall, 3 were an anterior, and one was a posterior dislocation. Five of the 6 patients suffered their injuries in March, most often around noon and a clear day. The snow was sugar-like in 5 of 6 cases. The maximum temperature on the days on which the injury was sustained was 0.8-6.9°C higher than the mean daily maximum. In 5 cases, injury occurred on a crowded slope. Difficulty in controlling the skis, an increased load on the lower part of the body, and a large number of skiers on the slopes may contribute to produce a dislocation of the hip joint.

### ●要旨

1987年12月から1993年4月の6年間に安比高原スキー場で経験した外傷性股関節脱臼例について検討した。6例中5例は男性であった。4例は転倒, 2例は立木との衝突で受傷した。転倒による4例中3例は前方脱臼で, 1例は後方脱臼であった。6例中5例は3月の晴れた正午ごろ受傷した。雪質は6例中5例が粗目であった。受傷日の最高気温は, 平年に比べて0.8-6.9度高かった。5例は混雑したゲレンデの受傷であった。スキーコントロールの難しさ, 下半身への負荷の増大, 混雑したゲレンデが股関節脱臼例に共通する要因であると思われた。

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## Introduction

Dislocation of the hip related to skiing is rare, and the causal factors are unclear<sup>1-3</sup>. To determine the causal and contributory factors in cases ski-related traumatic dislocation of the hip, we analyzed the mode of injury, the situation in which injury was sustained and the skiing conditions in 6 cases of such injuries.

## Subjects and Methods

Data were collected at the Appi Ski Resorts in the northwestern part of Iwate Prefecture, one of the largest ski areas in Japan. The total number of skier·days for this resort in the six years between December 1987 and April 1993 was 7,178,000<sup>4</sup>. During this period, 5,616 cases of injuries were treated at the resort's first aid station, and six of these had dislocated hips. The diagnosis was confirmed using medical records and radiograms from the hospitals to which the patients were transferred.

Data on the maximum atmospheric temperature and hours of sunlight were obtained from the Iwate Matsuo Meteorological Observatory, the observatory closest to the ski resort<sup>5</sup>.

## Results

Patients ranged in age from 8 to 46 years (Table 1). Five of the six patients were males. The injury affected left hip in 4 cases, and the right hip in 2

cases. Three of the 4 cases whose injury was related to a fall during skiing experienced anterior dislocations (Case 1-3), while one had a posterior dislocation (Case 4). The 3 cases of anterior dislocation resulted from forced abduction, external rotation and extension of the legs while the tips of the skis were open. In the case of posterior dislocation, the patient fell while he was attempting to take a photograph while skiing at a very low speed.

Both cases of collision involved posterior dislocations, accompanied by contralateral femoral fracture in one case (Case 5) and by ipsilateral distal epiphyseal disruption and a patellar fracture in the other (Case 6). These accompanying injuries suggested that a strong direct force was applied from the distal side of the femur along the long axis.

Five of the 6 patients suffered their injuries in March. Most of them occurred around noon, a clear day (5 cases); the day was cloudy in 1 case. The mean duration of sunshine was 3.7 hours in January, and 5.6 hours in March. On the days on which injuries were sustained, that mean durations of sunshine was longer by 1.2-4.4 hours. Visibility was good in all instances. Snow on the slope was sugar-like in 5 cases. Five of the injuries occurred on a crowded slope either on, or the day before, a holiday. In 3 cases the injury occurred on a gentle slope, and in 3 on an intermediate slope. The mean daily maximum temperature was 1.4°C in January and 5.8°C in March; the maximum temperature on the days on which the injury was sustained was 0.8-6.9°C higher than the mean daily maximum.

With regard to skiing skill, 3 of the accident victims were novice and 3 were intermediate skiers. The speed was considered safe speed in 3 cases and

Table 1 Summary of 6 Cases of Traumatic Dislocation of the Hip

	CASE 1	CASE 2	CASE 3	CASE 4	CASE 5	CASE 6
Date	3/23/90	1/13/91	3/6/93	3/27/88	3/21/89	3/22/91
Time	13:30	11:00	11:30	12:00	11:30	11:15
Age	21	25	26	33	46	8
Sex	man	women	man	man	man	man
Type of dislocation	anterior dislocation	anterior dislocation	anterior dislocation	posterior	posterior	posterior
Mode of injury	Epstein IIA	Epstein IIA	Epstein IIA	Epstein Type I	Epstein Type II	Epstein Type I
Level of experience	fall on the slope	fall on the slope	fall on the slope	fall while taking photo	collision with a tree	collision with a tree
Speed	intermediate	novice	intermediate	intermediate	novice	novice
Gradient	excessive	excessive	stationary	stationary	excessive	stationary
Weather	gentle	gentle	moderate	gentle	moderate	gentle
Sushine duration(hr)	clear	clear	clear	clear	cloudy	clear
Surface	8.8	5.5	6.8	10	7.3	9.8
Type of snow	smooth	deep snow	rough	gapped	gapped	smooth
Maximum temperature	sugar snow	fresh	sugar snow	sugar snow	sugar snow	sugar snow
Traffic	12.7 (°C)	3.2	9.3	9.9	6.6	8.0
	heavy	heavy	light	heavy	heavy	heavy





**Fig. 1 : Radiogram of the left hip joint of Case3 on the examination, showing anterior dislocation of the joint (Epstein type II A).**

reckless speed in 3. Bindings were of the newest "step-in type" in all cases, and were released at the time of injury in all but one case. Each patient was immediately transferred to a hospital. Manipulative reduction was performed under general anesthesia within 2.0-4.0 hours after the injury.

### Discussion

Ski-related traumatic dislocation of the hip joint is rare. This injury accounted for only 2 (0.022%) of the 9,120 ski injuries included in an American report for the years 1939-1976<sup>2</sup> and only 2 (0.025%) of the 8,000 ski injuries included in an Australian survey issued in 1986<sup>3</sup>. We found nearly 5-fold higher incidence (0.11%), suggesting an increase in its incidence. Nagata et al., who studied ski injuries that occurred at the Ishiuchi ski area in Nigata Prefecture, also voted an increased incidence of hip joint dislocation<sup>1</sup>.

Collision with a tree during downhill skiing produces severe injuries<sup>6</sup>. A strong force was likely to be applied from the distal side of the femur along the long axis similar to injuries sustained by colliding with the dashboard in an auto accident. In cases of falling, the external force was unlikely to exceed that incurred in other ski injuries. The type of injury seemed to be attributable to the position of the skier while falling.

Five of the 6 patients suffered their injuries in March, most often around noon and a clear day. At



**Fig. 2 : Radiogram of the left hip joint of Case5 on the first examination, showing posterior dislocation of the joint (Epstein type II). The patient underwent manipulative reduction under intravenous anesthesia 2 hours after sustaining injury.**

this time of year, direct sunlight and an increased temperature during the day can melt the surface of the snow, making it difficult for skiers to control their skis, and increasing the load on the lower part of their body. At this time of year, the slopes are often crowded with young students on vacation, which may increase the risk of ski accident. Difficulty in controlling the skis, an increased load on the lower part of the body, and a large number of skiers on the slopes may force some of them off the course to collide with a tree, or increases the occurrence of accidental falls, in rare cases producing a dislocation of the hip joint.

### Acknowledgments

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# Lumbar Spondylolysis of Judo Players and Long Distance Runners

## 柔道選手、長距離陸上選手の腰椎分離症

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### ●Key words

Spondylolysis : Judo Player : Long Distance Runner  
脊椎分離, 柔道選手, 長距離陸上選手

### ●Abstract

The purpose of this study was to evaluate lumbar injuries of Judo players and long distance runners. Nineteen male judo players and twenty-five long distance runners were evaluated by history, physical examination and standard radiographs. Judo players showed higher incidence of spondylolysis rather than long distance runners. It suggests that high incidence of spondylolysis in Judo players was brought from such factors as unique lumbar motions, specific spine stress, and vertebral bone maturity at the age when Judo players began to practice.

### ●要旨

我々は実業団男子柔道選手21名、長距離陸上選手25名の腰部障害を明らかにする目的で直接検診、レントゲン検査を行った。その結果、柔道選手21名中7名(33%)、長距離陸上選手25名中3名(12%)に腰椎分離症または腰椎分離すべり症を認めた。柔道選手に腰椎分離生が多発している原因として、競技特異的な腰椎運動性や競技開始時年齢等の要因が考えられた。

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## Introduction

Lumbar spondylolysis of Judo players has become one of the most widely discussed topics in orthopaedic lectures. But now, we do not have appropriate answer for the risk factors of the occurrence. The purpose of this study was to characterize the incidence of lumbar spondylolysis between Judo players and long distance runners in Japan.

## Materials and Method

Subjects of this study were twenty-one male Judo players and twenty-six long distance runners. Average age, height and weight of Judo players were 25.3 years old, 178 cm, 94.5 kg. Those of long distance runners were 23.3 years old, 169 cm, 55.4 kg.

Judo players began to practice Judo at 9.9 years old, and long distance runners began to run at 13.5 years old. Their average period of practicing Judo was 15.3 years, and it of long distance run was 9.8 years. At present, Judo players were training for 3 hours a day and 6 days a week. Long distance runners were training for 3 hours a day and 7 days a week.

They were evaluated by history, physical examination and standard radiographs. Some cases were taken of computed tomography or Magnetic Resonance Imaging.

## Result

Episode of low back pain was in 19 of all Judo players (90%) and in 21 of runners (80%). But no one indicated neurological deficit.

On the lumbar spine X-ray films, seven of Judo players (33%) showed spondylolysis (Fig. 1). Two cases of them showed spondylolytic spondylolisthesis in the fourth lumbar vertebrae, one case showed in the fifth. Four cases showed spondylolysis in the fifth. Three of runners (12%) showed spondylolysis. One of runners showed spondylolysis in the fourth and two of the them showed spondylolysis in the fifth (Table. 1).

## Discussion

The average incidence of spondylolysis in Japanese people is from four to seven percent. It is commonly proved that athletes shows high incidence of spondylolysis. The incidence rate of Judo players in our subjects was 33%. Ichikawa reported 29% in Judo players. The incidence rate of long distance runners in our subjects was 12%. Kobayashi reported 21% of spondylolysis in runners and jumpers.

Every report proved that the incidence of lumbar spondylolysis in Judo players was higher than in long distance runner. Why does Judo player have

Table 1 : X-ray findings

	Judo Players	Long Distance Runners
L4 spondylolysis	0	1
L4 spondylolytic spondylolisthesis	2	0
L5 spondylolysis	4	2
L5 spondylolytic spondylolisthesis	1	0
total	7/21 (33%)	3/26 (12%)

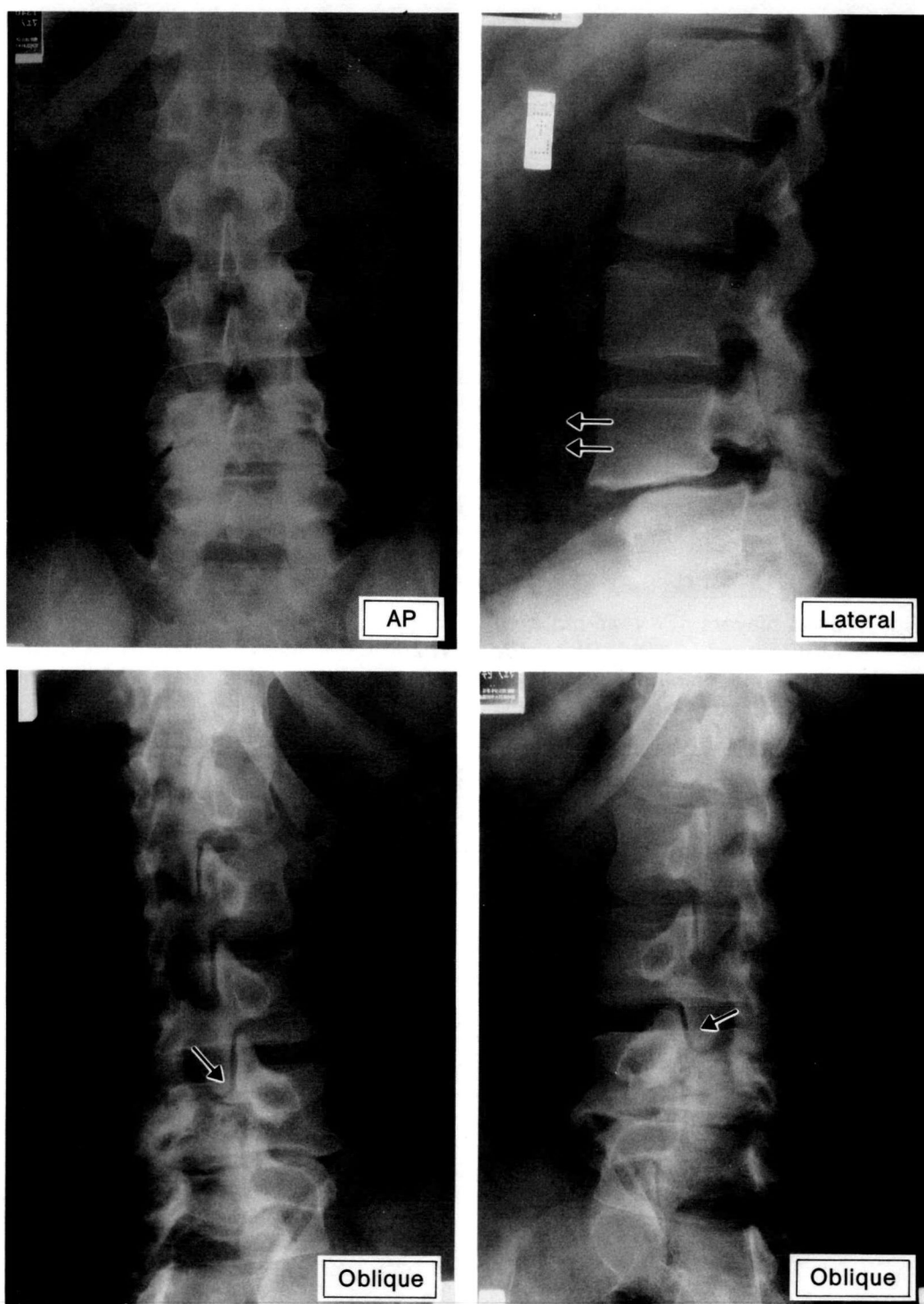


Fig. 1 : Lumbar Spine of Judo players (34 yr.)

X-Ray films proved that lumbar spine had spondylolytic spondylolisthesis of L4. The grade of spondylolisthesis by Myevding is gradel. Osteoarthritis in L4/5 is also seen.



Fig. 2 : Judo players (24 year-old)  
MRI Left side : TW 1, Right side : TW 2  
He is one of elite Judo players in Japan. Lumbar disc degeneration and herniation can be seen in L4/5.

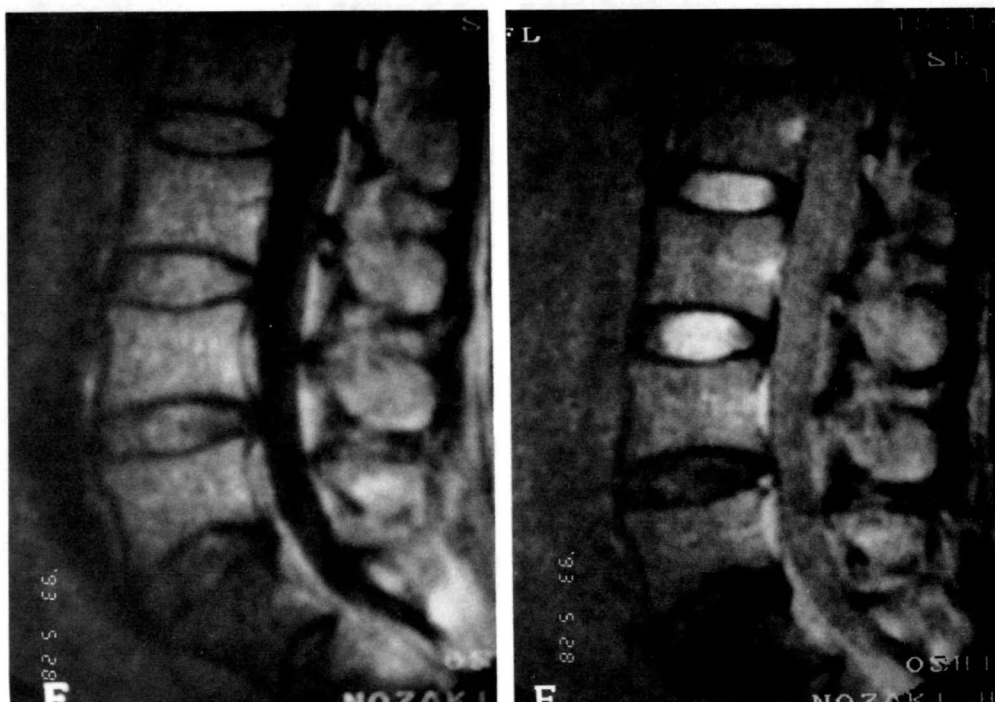


Fig. 3 : Marathon Runner (34 year-old)  
MRI Left side : TW 1, Right side : TW 2.  
He was a Marathon runner of Olympic game. Lumbar disc degeneration can be seen in L4/5 and L5/S1.

higher incidence of lumbar spondylolysis?

Technique of Judo, especially in throwing, needs lumbar hyperextension to hyper-flexion with rotation. This motion is so over-loaded to the facet joints, that spondylolysis occurred frequently in Judo players.

We experimented with a cause of spondylolysis using a three dimensional finite element method. That result shows when vertical force was put on the interarticular joint, that loads concentrated on the pars interarticularis. It suggests that stress reaction of the pars interarticularis leads spondylolysis.

And bone maturity when a athlete participated in sports is one of the factors causing spondylolysis. In our subjects, Judo players began to practice Judo at 9.9 years old. And long distance runners began to run at 13.5 years old. We suspected that almost spondylolysis occurs under fourteen or fifteen years old.

When does spondylolysis develop into spondylolisthesis? From our follow-up survey from 1991 to 1994 of Judo players, another spondylolisthesis had not occurred nor developed during the period of study. It was suspected that spondylolisthesis occurred at just time when spondylolysis occurred or as soon as later in growth period. And it was thought that spondylolisthesis would not increase worse step by step.

Some cases of our subjects were examined by magnetic resonance imaging. Both cases do not have spondylolysis. Fig. 2 shows a elite Judo athlete and Fig. 3 shows Olympic Marathon runner. These Fig. 1 & 2 proved degeneration in intervertebral disc. We shall study degeneration of intervertebral disc in players.

### Conclusion

1. Judo players showed higher incidence of spondylolysis rather than Long distance runners.

2. It suggests that high incidence of spondylolysis in Judo players was brought from such factors as unique lumbar motions, specific spine stress, and vertebral bone maturity at the age when Judo players began to practice.

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# Muscle Strength Characteristics of Knee and Trunk in Judo Players

## 柔道選手の膝・腰部の筋力特性

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### ●Key words

Judo player : Trunk : Knee

柔道選手, 腰部, 膝

### ●Abstract

The purpose of this study was to evaluate muscle strength of knee and lumbar spine in Judo players. Nineteen male Judo players were evaluated by history, physical examination and standard radiographs. There was no significant difference between Judo players with lumbar spondylolysis and them without it. Judo players with meniscus injuries showed lower knee extension muscle strength (32.78 Nm/Kg) rather than intact Judo players (39.69 Nm/Kg) ( $P < 0.05$ ). Judo players with meniscus injuries, especially, need knee extension muscle training for their extended competitive capacity.

### ●要旨

我々は実業団男子柔道選手の腰部・膝筋力特性を明らかにする目的で直接検診, レントゲン検査および Chattecx 社製 KIN-COM による体幹前屈・後屈筋力, 膝伸展・屈曲筋力測定を行った。その結果, 体幹前屈・後屈筋力の点からは腰椎分離ありと腰椎分離無しの群に有意の差を認めなかったが, 膝半月板損傷群では膝伸展筋力が有意に低下していた。また膝屈曲筋力はコントロール群より柔道選手群の方が有意に強力であり, 競技特異性によるものと考えられた。

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## Introduction

The purpose of this study was to characterize the muscle power capabilities and to evaluate sports injuries of knee and lumbar spine of Judo players in Japan.

## Materials and Method

Subjects of this study were nineteen male Judo players and ten controlled male who had not practiced Judo. Their average age, weight and height of Judo players were 24.4 years old, 178 cm, 103.5 kg. Each of them in controlled group was 26.8 years old, 174.3 cm and 80.1 kg.

Judo players have been practicing Judo three hours a day and six days a week. They had been practicing for 15.3 years. They had started to practice Judo at 9.9 years old in average.

These two groups were evaluated by physical examination and standard radiographs of knee and lumbar spine. Knee and trunk muscle strength were evaluated at maximum isometric powers by KIN-COM (Chattecx USA).

## Results

Lumbar X-ray films proved that seven of all Judo athlete had lumbar spondylolysis or

Table 1 : Lumbar Spine Disorders of Judo Players

L4 Spondylolytic-Spondylolisthesis	2
L5 Spondylolysis	4
L5 Spondylolytic-Spondylolisthesis	1
Total	7/19 ( 33% )

spondylolytic-spondylolisthesis. Two cases showed spondylolytic spondylolisthesis in the fourth lumbar spine. Four cases had spondylolysis in the fifth. One case had spondylolytic spondylolisthesis in the fifth (Table 1).

Fourteen knees in ten Judo players had ligamentous injuries. Medial collateral ligamentous injuries were recognized in eight cases, anterior cruciate ligamentous injuries were in four cases, lateral collateral ligamentous injuries and posterior cruciate ligamentous injuries were in two cases each. Three cases showed meniscus injuries (table 2). Two of three meniscus injuries were proved under arthroscopy.

From trunk muscle strength tests, both trunk flexion and extension power indicated no significant difference between Judo players and controls. And there was also no significant difference between

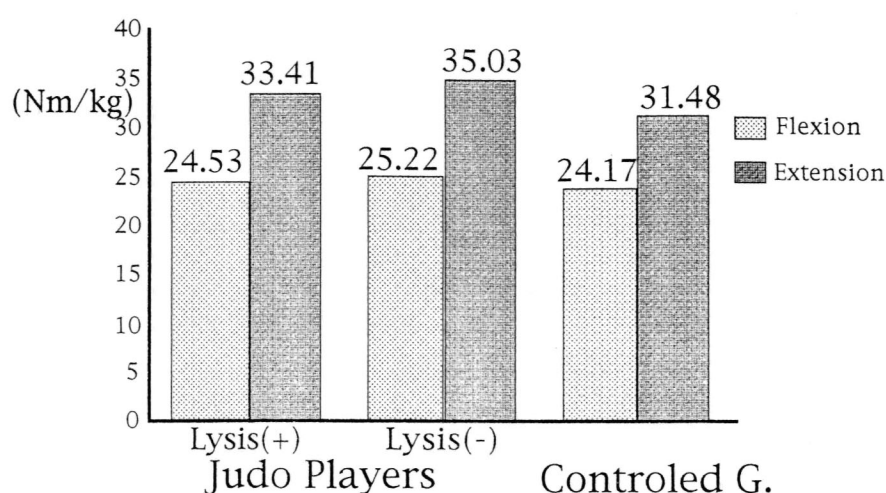


Fig. 1 : Trunk Strength

From trunk muscle strength tests, both trunk flexion and extension power proved no significant difference between Judo players and normal controls.

**Table 2 : Knee Injuries of Judo Players**

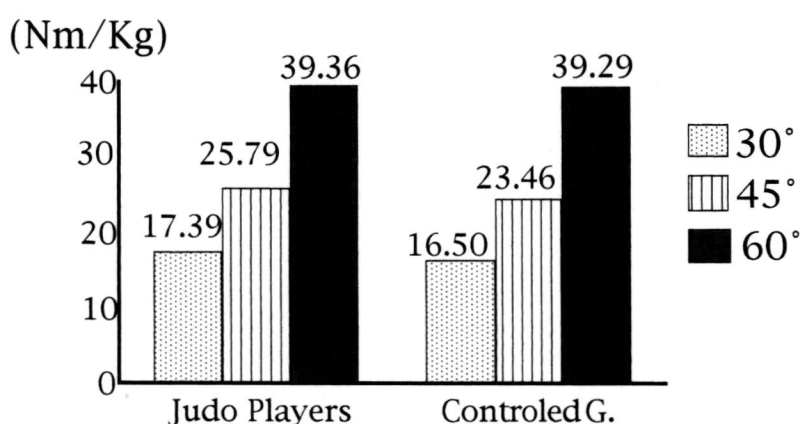
MCL Injury	8
ACL Injury	4
LCL Injury	2
PCL Injury	2
Meniscus Injury	3
Total	15/19 ( 79% )

Judo players with spondylolysis or spondylolytic spondylolisthesis and without such a lesion (Fig. 1).

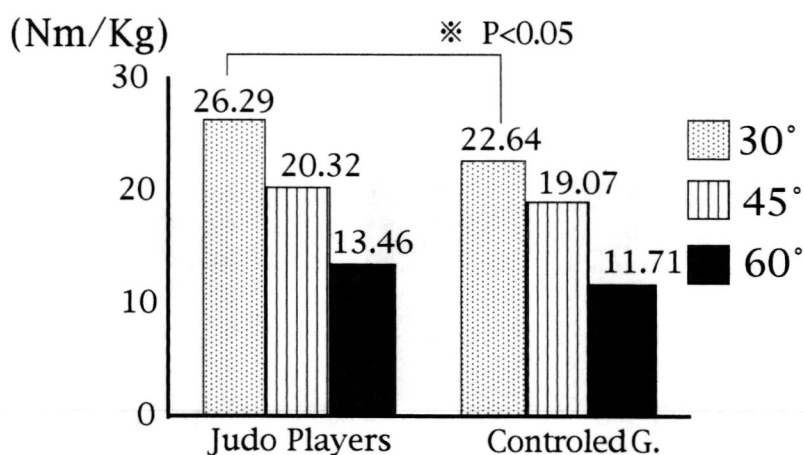
Isometric power was measured at thirty degree, forty-five degree and sixty degree. Maximum knee extension power was obtained at sixty degree. But knee extension power test showed no significant difference (Fig. 2).

Maximum knee flexion power was obtained at thirty degree. Knee flexion power test proved that Judo players had significant ( $P < 0.05$ ) stronger power than normal controls (Fig. 3).

Subsequently, Judo players were divided into three groups ; the first : players who had no trouble

**Fig. 2 : Knee Extension**

Isometric power was measured at thirty degree, forty-five degree and sixty degree. Maximum knee extension power was obtained at sixty degree. But knee extension power test showed no significant difference.

**Fig. 3 : Knee Flexion**

Maximum knee flexion power was obtained at thirty degree. Knee flexion power test proved that Judo players had significant ( $P < 0.05$ ) stronger power than normal controls.

in knee joints, the second : ligamentous injury, and the third : meniscus injuries they had. Judo players with ligamentous injuries had statistically the same level power as normal knee group. Judo players with meniscus injuries showed statistically ( $P < 0.05$ ) lower knee extension power (32.78 Nm/Kg) rather than normal Judo players (39.69 Nm/Kg) (Fig. 4).

## Discussion

Technique of Judo play, especially in throwing technique for another Judo players, needs lumbar hyper-extension to hyper-flexion with rotation. It was thought that this trunk motion made stress for lumbar spine and these continuous stress brought low back pain on Judo players.

The incidence rate of spondylolysis of our subjects was 33%. Ichikawa reported high incidence of spondylolysis in Judo players 29.2% and Yamaji reported 20.2% of spondylolysis in college Judo players.

In the point of extension-flexion ratio of trunk muscle strength, Kanazawa reported that Judo players who had low back pain, showed increase of extension-flexion ratio. In our study, there was not significant change of extension-flexion ratio. We suspected that excellent extension-flexion ratio of trunk prevented low back pain on Judo players who had spondylolysis.

At thirty degree, there was statistical difference in maximum knee flexion power between Judo players and normal controls. Prior to attack in standing tricks, knee should be slightly flexed at about thirty degree, because it is impossible to take enough power on complete extension of knee. Effective performance is ensured when knee eccentric flexion power is strong for maximum energy output. We considered that strong knee extension power at thirty degree proved one of characteristics in Judo.

Judo players with meniscus injuries, showed lower knee extension power. It was thought that weak knee extension power resulted from feedback phenomenon of meniscus injuries. So they must be not only treated appropriately but they need knee extension muscle training for their extended competitive capacity.

## Conclusion

1. There was not significant change of extension-flexion ratio in trunk power between Judo players with and without spondylolysis. We considered that excellent extension-flexion ratio of trunk prevented low back pain on Judo players who had spondylolysis.
2. There was statistical difference in maximum knee flexion power between Judo players and normal controls. We considered that strong knee flexion power proved one of characteristics

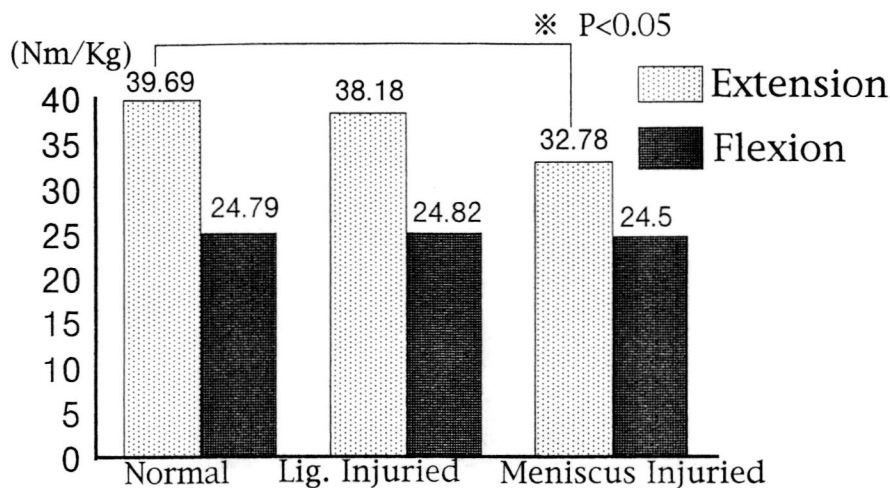


Fig. 4 : Knee of Judo Players

Judo players with ligamentous injuries had statistically the same level power as normal knee group. Judo players with meniscus injuries showed statistically ( $P < 0.05$ ) lower knee extension power (32.78 Nm/Kg) rather than normal Judo players (39.69 Nm/Kg).

in Judo.

3. Judo players with meniscus injuries, showed lower extension power of knee. They needs knee extension muscle training for their extended competitive capacity.

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# A Dynamic Proximal Realignment Procedure for Recurrent Patellar Dislocation and Subdislocation in Young Athletes

若年スポーツ愛好者の再発性膝蓋骨脱臼・亜脱臼に対する動的近位制動術

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## ●Key words

Recurrent patellar dislocation : Dynamic realignment procedure : Electromyogram  
再発性膝蓋骨脱臼, 動的制動術, 筋電図

## ●Abstract

The purpose of this study was to evaluate the clinical and radiological results of a dynamic realignment procedure with semitendinosus muscle in young athletes. There were 10 patients (1 top athlete, 5 competitive athletes and 4 recreational athletes) with a mean age of 13.4 years. Seven of them had recurrent patellar dislocation and 3 had recurrent patellar subdislocation. The surgical technique was modified from that reported by the Uezaki. During follow-up for a mean of 62.5 months, pain and giving way disappeared in 4 patients, decreased in 5 and did not decrease in one. The tilting angle improved from a mean of  $20.1^{\circ}$  to  $8.8^{\circ}$  and the lateral shift ratio improved from 27.2% to 12.4%. There were no recurrences of patellar dislocation or serious complications associated with the surgery during the follow-up period. Using our rating system for overall results, we found that in 2 patients the results were excellent, in 6 they were good, one was fair and one was poor. It was concluded that this dynamic realignment procedure with semitendinosus muscle can help to prevent further patellar dislocation or subdislocation and to allow a quick return to athletics.

## ●要旨

本研究の目的は若年スポーツ愛好者の膝蓋骨脱臼・亜脱臼に対する動的制動術の臨床的、X線学的成績を評価することで、対象は10例（再発性脱臼7例、亜脱臼3例）、年齢は平均13.4歳。手術術式は上崎変法を用いた。平均62.5カ月の追跡調査では疼痛と giving way は5例に消失、4例に改善、1例は不変。tilting angle は平均 $20.1^{\circ}$ が $8.8^{\circ}$ 、lateral shift ratio は27.2%が12.4%に改善。総合評価は優2例、良6例、可と不可それぞれ1例であった。また、追跡期間中に脱臼の再発や重大な術後合併症は認められなかった。本術式は早期のスポーツ復帰と膝蓋骨脱臼・亜脱臼の再発予防において有用な方法である。

Recurrent patellar dislocation or subdislocation is a common cause of patellofemoral disorders in young athletes. Various surgical techniques<sup>1), 2), 6)</sup> for its treatment have been described. These can be broadly classified into proximal and distal realignment procedures. Distal realignment procedures have been widely used, but some serious complications associated with surgery, such as growth plate damage and osteoarthritic changes, have been reported. In contrast, the complications of proximal realignment procedure are relatively few and minor, and we have, therefore, used this procedure for patients under fifteen years of age.

The purpose of this study was to evaluate the clinical and radiological results of a dynamic proximal realignment procedure in young athletes with recurrent patellar dislocation or subdislocation.

## Materials and Methods

Between 1986 and 1990, 10 athletes were treated with a dynamic proximal realignment procedure with semitendinosus muscle (Table 1). There were 8 girls and 2 boys with a mean age of 13.4 years (range : 12 to 15 years). Seven of the patients had recurrent patellar dislocation and 3 of them had recurrent patellar subdislocation. The follow-up period averaged 62.5 months, with a range of 35 to

93 months.

The patients were either frequently injured during various sports activities or related the onset of their symptoms to sports events (Table 2).

We modified the surgical procedure<sup>9)</sup> described by Uezaki (Fig. 1). A small medial parapatellar skin incision was made and semitendinosus muscle was exposed and cut at its insertion. A bony tunnel with a diameter of 5 mm and a key hole were made in the patella. The tendinous portion of semitendinosus

Table 2 Causative Sports

Volley Ball .....	2
Gymnastics .....	2
Field and Track... Events	2
Side Jumping.....	2
Basket Ball .....	1
Kendo.....	1

Table 1 Materials

Patients :	10 cases , 10 knees ( 8 girls and 2 boys)
Age :	a mean of 13.4 years (12-15 years )
classification:	7 recurrent dislocation, 3 recurrent subdislocation
Follow-up time :	a mean of 62.5 months ( 35-93months)

Table 3 Criteria for assessment of the results

items assessment	pain or giving way	radiological improvement	limitaion of ROM	overall results
Excellent	none	normal	none	all is excellent
good	sometimes	more than 50%	$\leq 10^\circ$	worst is good
fair	often	less than 50%	$11-20^\circ$	worst is fair
poor	usual	none or worse	$\geq 21^\circ$	worst is poor

$$\text{radiological improvement ratio} = \frac{\text{preop. varue} - \text{postop. varue}}{\text{preop. varue} - \text{normal varue}} \times 100 (\%)$$

muscle was passed through the tunnel and pulled tightly. The distal end of tendon was rolled and sutured, and inserted in the key hole.

The knee was not immobilized and ROM exercises with CPM as well as isometric quadriceps drill were begun on the second postoperative day. Weight bearing was begun from 2 weeks after surgery and full weightbearing was permitted 6 weeks postoperatively.

The subjective evaluntion consisted of the symptoms of pain and giving way. The objective evalua-

tion consisted of range of motion and radiological findings. The tilting angle<sup>8)</sup> and the lateral shift ratio were measured with the knee flexed 30 degrees axially. The overall results were assessed with pain or giving way, radiological improvement, and the limitation of range of motion. The results were rated as excellent, good, fair, or poor according to the worst rating obtained for each evaluation item (Table 3).

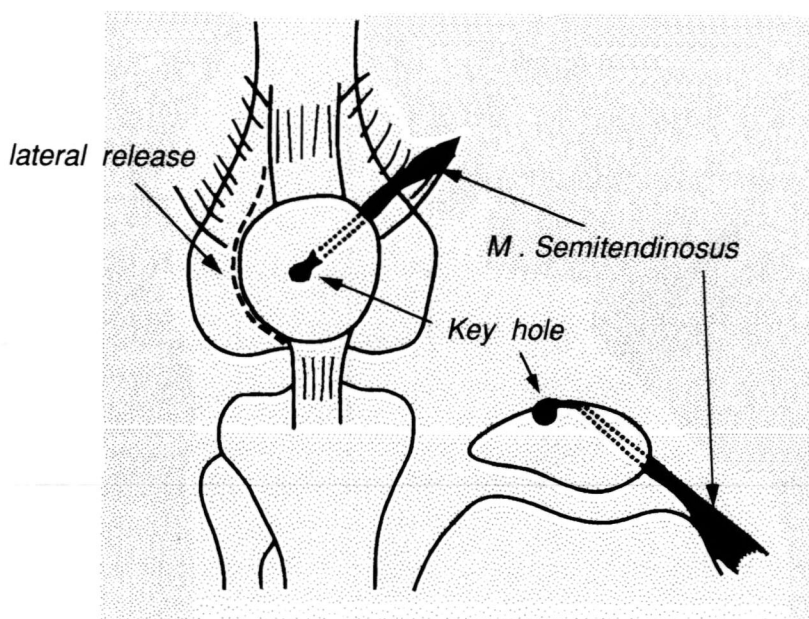


Fig. 1 Surgical procedure



Table 4 Sports activities

activity level	preop.	postop.
top athlete	1 case	0
competitive athlete	5 cases	2 cases
recreational athlete	4 cases	2 cases
non athlete	0	6 cases

Table 5 Over all results

Excellent	2 cases
Good	6 cases
Fair	1 case
Poor	1 case
Total	10 cases

## Results

After surgery, pain and giving way disappeared in 4 patients, decreased in 5, and did not decrease in one. The tilting angle improved from a mean of  $20.1^{\circ}$  to  $8.8^{\circ}$ , and it was within normal limits in all patients (Fig. 2). The lateral shift ratio improved from 27.2% to 12.4%, and it was within normal limits in 7 patients.

Before surgery, one of the patients had been classified as a top athlete, 5 as competitive athletes, and

4 as recreational athletes (Table 4). Four of them returned to sports postoperatively : 2 as competitive athletes, and 2 as recreational athletes. The reasons that the other 6 discontinued sports activities were : no time to spare ( $n=2$ ), no reason ( $n=3$ ), and pain ( $n=1$ ).

By our rating system for overall results, 2 of the patients were rated excellent, 6 good, 1 fair and 1 poor (Table 5).

During follow-up, there were no recurrences of patellar dislocation or serious complications associated with the surgery.

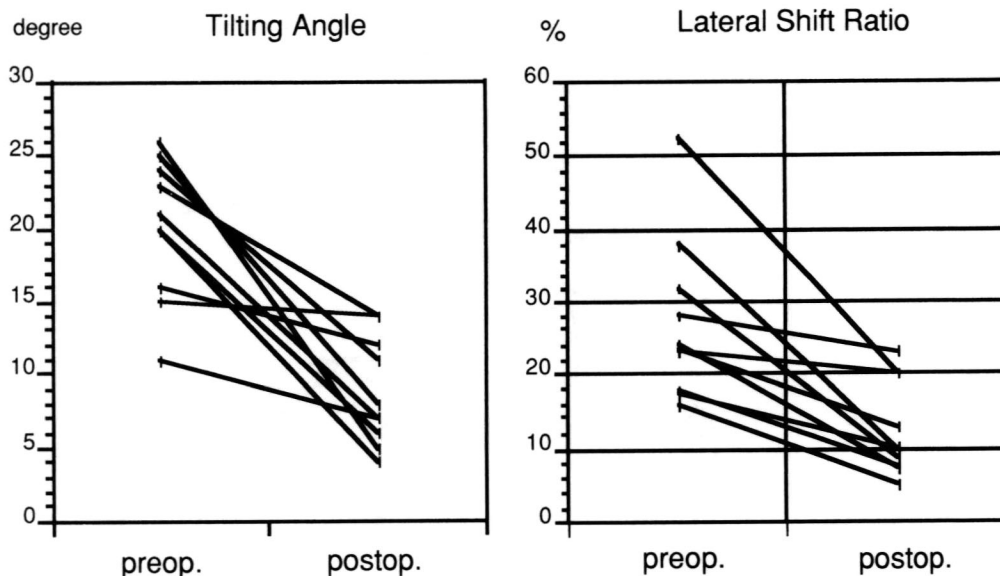


Fig. 2 Radiological results

## CASE REPORT

### CASE 1 : 12-year-old girl

She twisted her left knee during the shot put in 1986 and visited our hospital immediately. The knee was markedly swollen and the patella was dislocated laterally. A total of 70 ml of blood was removed from the joint. A manual reduction was performed, but radiographic examination after reduction revealed patellar subdislocation with a large osteochondral fracture. An operation was done.

At the time of the operation, an osteochondral fragment (2 cm × 2 cm) was found and was fixed to the patella with absorbable sutures. Then semitendinosus muscle was transferred to the patella.

The osteochondral fracture was completely united

1 year after surgery. By 89 months after surgery, the tilting angle and the lateral shift ratio were in their respective normal ranges (Fig. 3). She has since returned to her life as a student without any symptoms.

### CASE 2 : 12-year-old girl

She twisted her right knee during the high jump in 1983. After that, she often felt her knee giving way during sports. She belonged to the All Japan junior of volley ball team. She wanted to return to athletic competition and visited our hospital in 1986.

By 93 months after surgery, the radiological examination demonstrated that the tilting angle and lateral shift ratio was in the normal range (Fig. 4). She feels mild pain during sports but works as an instructor at a swimming club.

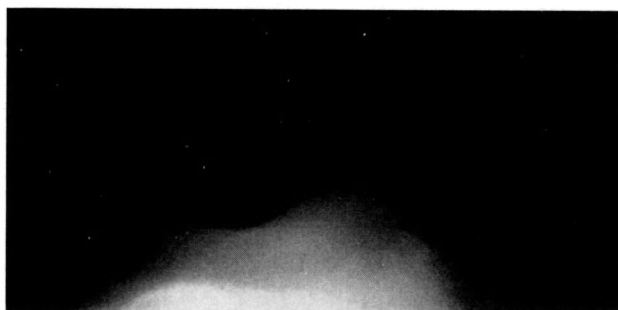


Fig. 3a : A preoperative roentgenogram of the knee in case 1. : The tilting angle was 21° and the lateral shift ratio was 52.5%.

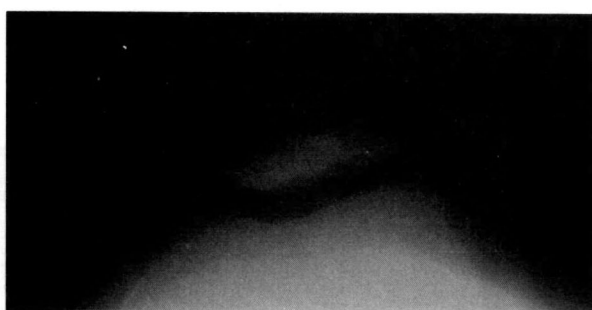


Fig. 3b : A postoperative roentgenogram of the knee in case 1. : The tilting angle improved to 7° and the lateral shift ratio was improved to 20%.

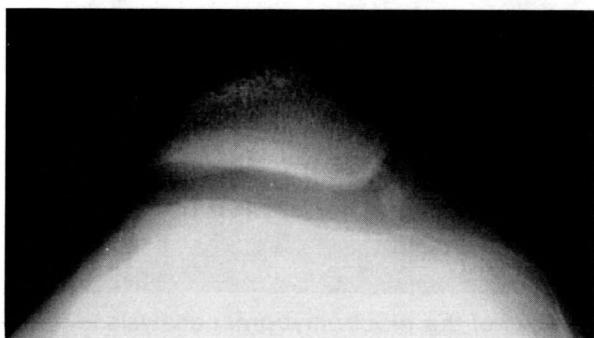


Fig. 4a : A preoperative roentgenogram of the knee in case 2. : The tilting angle was 26° and the lateral shift ratio was 38%.

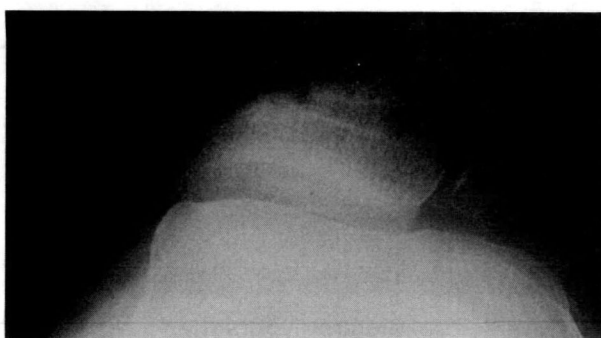


Fig. 4b : A postoperative roentgenogram of the knee in case 2. : The tilting angle improved to 5° and the lateral shift ratio improved to 10%.

## Discussion

Recurrent patellar dislocation frequently occurs in young people with patellofemoral malalignment<sup>5)</sup> such as genu valgus, increased quadriceps angle, patella alta, and imbalance of quadriceps muscle. Abnormal tracking of the patella causes pain or giving way, and may damage the articular cartilage, and may eventually result in osteoarthritis. MacNab<sup>7)</sup> found that untreated recurrent dislocation can eventually result in severe patellofemoral osteoarthritis.

Surgical procedures are therefore aimed at correcting patellofemoral malalignment and preventing osteoarthritis. The treatments for malalignment are usually successful, but some serious complications have been reported. Heywood<sup>4)</sup> reported 4 cases of genu recurvatum when the distal realignment procedure was performed in children under the age of 14. MacNab also emphasized the risk of this procedure before the fusion of epiphysial growth plate. According to Hampson<sup>3)</sup>, Hauser's procedure may hasten

rather than retard the development of osteoarthritic changes in the patellofemoral joint.

The results of this study suggest that dynamic proximal realignment can relieve symptoms and prevent further patellar dislocation. There were no serious complications associated with the surgery after a mean of 62.5 months of follow-up. This procedure is relatively simple and safe for the treatment of young patients with open epiphysis. Moreover, post-operative immobilization is not necessary, which avoids the limitation of knee motion and allows for a quick return to sports.

Patellofemoral stability and congruity depend on the balance<sup>10)</sup> of the quadriceps muscle. It might be expected that the transferred semitendinosus muscle would pull the patella medially during knee motion and prevent patellar dislocation, but this has not been investigated in detail. To find out how dynamic proximal realignment stabilizes the patella, we analyzed the electromyogram (EMO) records with ARIEL CES (Fig. 5a). EMG records were obtained after surgery with surface electrodes from the rec-

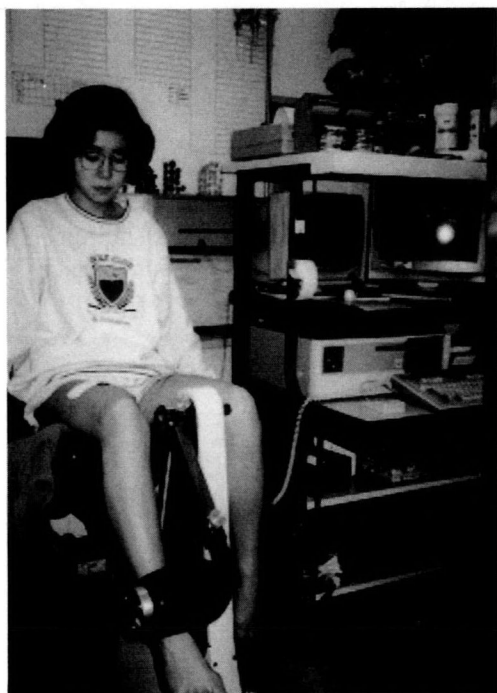


Fig. 5a : The electromyogram analysis with ARIEL CES.

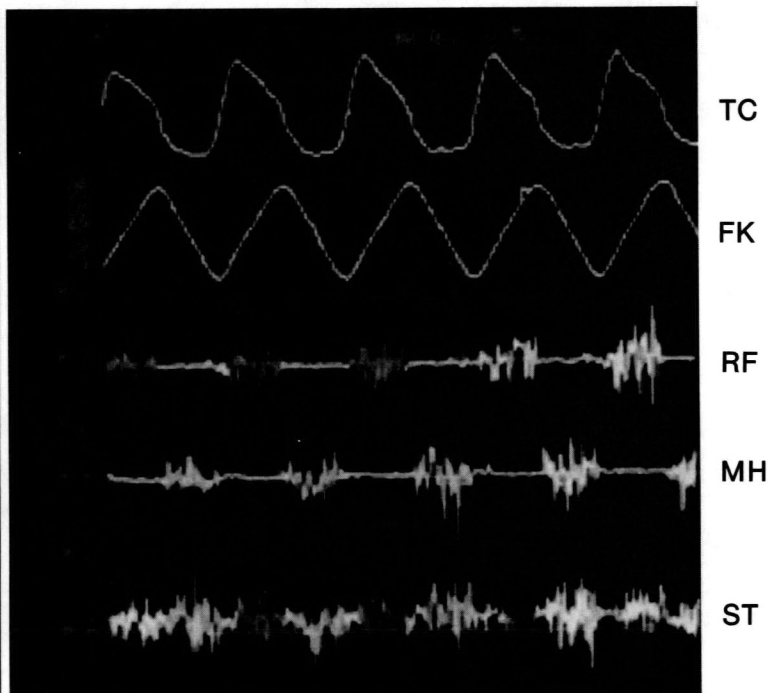


Fig. 5b : The results of the electromyogram analysis. TC : torque Curve, FK : flexion angle of the knee, RF : EMG activity of rectus femoris muscle, MH : EMG activity of medial hamstrings muscle, ST : EMG activity of transferred semitendinosus muscle

tus femoris muscle, medial hamstrings and transferred semitendinosus muscle. EMG activity was observed in transferred semitendinosus muscle during both knee extension and flexion (Fig. 5b). These data suggest that transferred semitendinosus dynamically stabilize the patella, and pulls it medially during knee motion.

### Summary

We evaluated the clinical and radiological results of a dynamic proximal realignment procedure in 10 young athletes with recurrent patellar dislocation or subdislocation. The tilting angle improved from a mean of  $20.1^\circ$  to  $8.8^\circ$ , and the lateral shift ratio improved from 27.2% to 12.4%. The overall results were rated as excellent in 2 cases, good in 6, fair in 1, and poor in 1. There were no serious complications associated with the surgery after a mean of 62.5 months of follow-up. Electromyogram analysis with ARIEL CES suggested that transferred semitendinosus muscle dynamically stabilizes the patellar tracking. This procedure can help to prevent further patellar dislocation and subdislocation and to allow for a quick return to sports.

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# Superior Labrum Injury of the Shoulder in Sports

## スポーツにおける肩上方関節唇損傷

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### ●Key words

Superior labrum injury : Sports : Arthroscopy  
上方関節唇損傷, スポーツ, 関節鏡

### ●Abstract

We treated nine patients who had been diagnosed with superior labrum injuries by arthroscopic methods. All patients complained of pain when the shoulder was elevated, 5 patients complained of a feeling of instability, and 1 patient complained of a feeling of the shoulder catching when moving.

Arthroscopic debridement was performed in 2 cases, arthroscopic resection of labrum in 2 cases, arthroscopic stapling in 1 case, and arthroscopic multiple suture (Caspari method) in 4 cases. Elevation pain disappeared completely in 8 cases, the instability sensation disappeared in 5 cases, and the click disappeared. 8 cases started playing their sports again, and 5 out of these 8 cases made a complete recovery. We believe that arthroscopic treatment is the best method for treating superior labrum injuries in athletes.

### ●要旨

スポーツ外傷により発症した肩関節上方関節唇損傷 (SLAP lesion) に対して関節鏡視下に治療し、その成績とスポーツ復帰について検討した。対象は SLAP lesion の診断で手術を行なった9例である。術前の症状は肩挙上時痛9例、肩の不安定感5例、運動時の肩の引っかかり感1例であった。関節鏡視下にデブリードメントのみ2例、部分切除2例、ステープル固定1例、multiple suture (Caspari 法) 4例を行なった。術後挙上時痛は8例で消失した。不安定感とクリックは全例消失した。8例が元のスポーツに復帰し、このうち5例は完全復帰した。関節鏡視下手術は侵襲が少なく損傷部の切除や修復が可能であり、スポーツにおける上方関節唇損傷 (SLAP lesion) に対して有用である。

## Introduction

A superior labrum injury of the shoulder sometimes occurs in sports due to trauma or over-use. Patients with superior labrum injuries have vague complaints such as elevation pain, instability, and a catching sensation in the shoulder.

A definite diagnosis is difficult without using arthroscopy. Also treatment by arthroscopic methods is difficult.

We treated a total of nine cases with superior labrum injuries by arthroscopic methods. Here we report the clinical results and the degree of the recovery of the sports activities.

## Materials & Methods

Nine patients who had been diagnosed with superior labrum injuries were the subjects of this study. The injuries resulted from following sports : two cases from baseball, two from skiing, one from water skiing, one from snow board, one from ice hockey, one from soccer, and one from sumo-wrestling. Each of them had an episode of trauma. Four cases occurred by direct blows to the shoulder and five cases from indirect blows (Table 1). The average age was 23.8(16-33) years old.

All patients complained of pain on shoulder elevation, 5 of a sensation of instability and 1 of a catching sensation. Six patients showed a positive painful arc sign, 4 patients showed a positive impingement sign, 4 showed a positive Speed test, and 4

Table 1 Type of Injury

1) direct blow	4
• ski	
• ice hockey	
• sumo-wrestling	
• soccer	
2) indirect blow	5
• ski	
• water ski	
• snow board	
• baseball	
• baseball	

Table 2 Clinical signs

1) Painful arc sign	6	(67%)
2) Impingement sign	4	(44%)
3) Speed test	4	(44%)
4) Apprehension test	4	(44%)
5) Clunk test	1	(11%)

showed positive anterior or inferior apprehension. One case showed a positive in the Clunk test (Table 2).

We confirmed detachment of the superior labrum from the glenoid in six of the nine cases (67%) by pre-operative CT arthrogram. Arthroscopic debridement was performed in 2 cases, arthroscopic resection of labrum in 2 cases, arthroscopic stapling in 1 case, and arthroscopic multiple suture (Caspary<sup>1)</sup> method) in 4 cases.

## Results

According to Snyder's classification<sup>2)</sup>, 2 cases had type 1 SLAP lesion, 5 had type 2, and 2 had type 3 in the operation (Table 3). Elevation pain disappeared completely in 8 cases, the instability sensation disappeared in 5 cases, and the click disappeared. Five of the 9 patients were able to make a complete come back in their previous sports, 3 patients were able to make a partial come back, and 1 patient was not able to make a come back at all.

## Case presentation

A-29-year-old male. His chief complaint was elevation pain of the right shoulder. He had an episode of a trauma that was falling while riding a snow board and suffering forced abduction forward

Table 3 Arthroscopic findings

• TYPE 1 (fraying)	2
• TYPE 2 (detachment)	5
• TYPE 3 (bucket-handle tear)	2
• TYPE 4 (degeneration)	0

flection. In the examination of his shoulder, the positive clinical signs were anterior apprehension, impingement sign, and a painful arc sign. As conservative treatment was ineffective, so we decided to carry out arthroscopic treatment.

Arthroscopy revealed that the patient was a type 2 SLAP lesion of Snyder's classification. We repaired the lesion using Caspari's suture method (Fig 1). In the pre-operative CT arthrogram, we could see air interposed between the labrum and the glenoid rim. And 5 months after the Caspari's suture repair, air interposed between the labrum and the glenoid rim was not seen (Fig 2).

### Discussion

The superior labrum is the attachment of the long

head of the biceps, which contributes to anterior instability. According to Cooper<sup>3)</sup> in superior labrum injuries, torsional rigidity decreases and inferior glenohumeral strain increases, which gives rise to anterior instability. A superior labrum injury is caused by trauma or overuse of the shoulder from a movement such as throwing. In trauma, Snyder emphasizes compression loading of the shoulder in a flexed and abducted position. Andrews<sup>4)</sup> emphasizes throwing stress on the anterosuperior labrum at the cocking phase, and on the posterosuperior labrum at the follow-through. Grauer<sup>5)</sup> emphasized traction and active biceps contraction (Fig 3).

Snyder called the superior labrum injury, an SLAP lesion, and classified it into 4 types : fraying (type 1), detachment (type 2), bucket-handle tear (type 3), and degeneration (type 4) (Fig 4).

Diagnosis of a superior labrum injury is difficult.

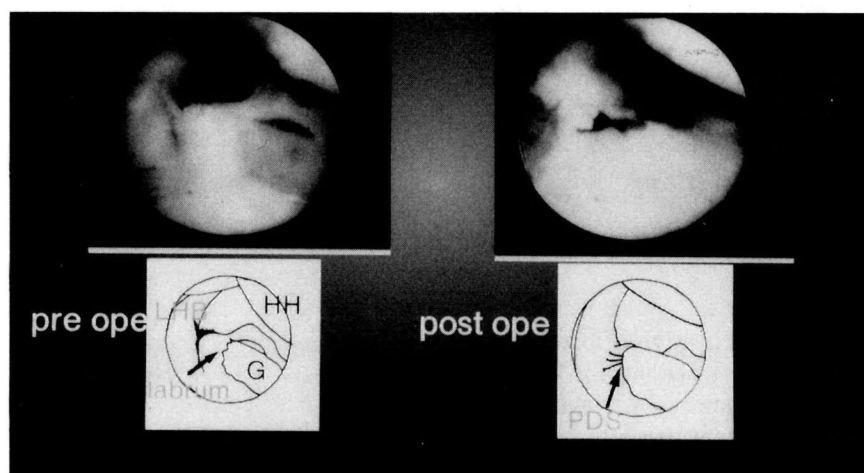


Fig. 1 Arthroscopic findings

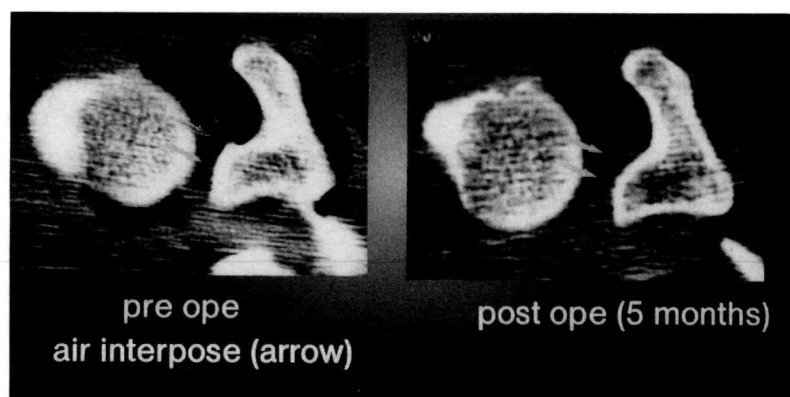


Fig. 2 CT arthrogram



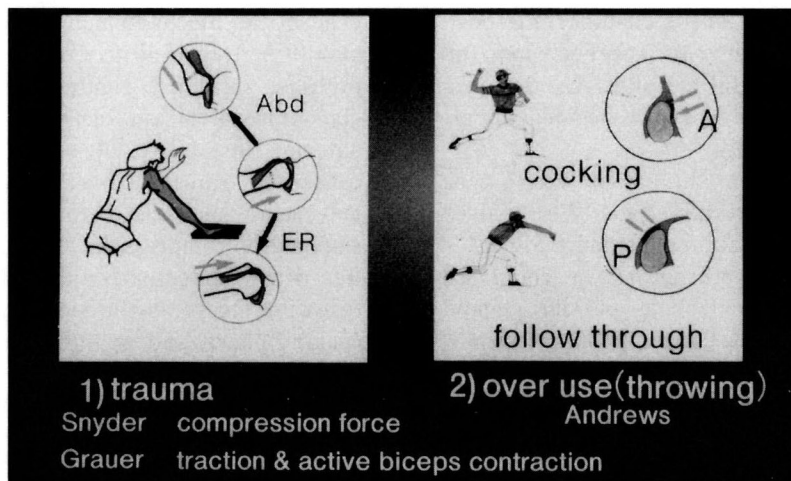


Fig. 3 Mechanism of injury

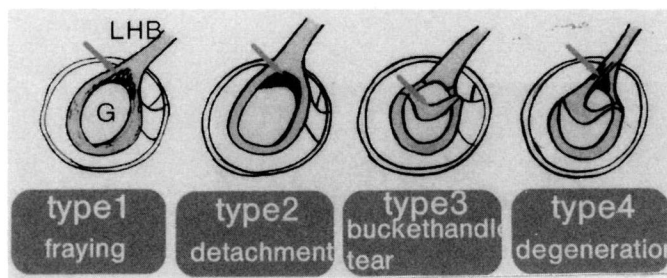


Fig. 4 Classification of Snyder

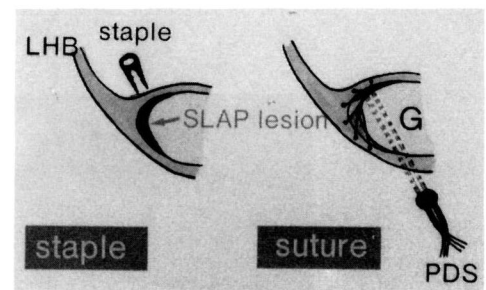


Fig. 5 Operation methods

A CT arthrogram can only be effective before an operation. Arthroscopy is the best method for diagnosis. Usually conservative treatment is ineffective, and surgical treatment with debridement, resection and repair is necessary. We use the staple and suture method. Staple fixation is easy and stable but sometimes causes loosening or impingement on the humeral head, and now, we basically use Caspari's suture technique (Fig 5).

### Conclusion

Superior labrum injuries sometimes occur in sports activities. Diagnosis of the lesion is difficult because of the unclear symptoms. A CT arthrogram is useful for pre-operative diagnosis of the lesion.

We believe that arthroscopy is the best method for treating superior labrum injuries in athletes.

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# Arthroscopic Reduction and Pull-out Suture for Displaced Fractures of the Intercondylar Eminence of the Tibia

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Jong Hoon Cho

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## ●Key words

Fracture of the intercondylar eminence of the tibia, arthroscopic-assisted pull-out suture.

## ●Abstract

The purpose of this paper is to demonstrate the effectiveness of the arthroscopic treatment for the displaced fractures of the intercondylar eminence, and the technique of the arthroscopic-assisted reduction and the fixation with pull-out suture.

Seven patients underwent the arthroscopic surgery for these displaced fractures and were followed up from fifteen months to thirty-one months. There were five fresh fractures and two of the displaced nonunion of fractures resulted in the lack of extension at the involved knees.

In all of the patients the avulsed fragments were reduced arthroscopically, and fixed by the arthroscopic-assisted pull-out sutures. At follow up, all but one patient returned to normal life activity and preinjury sports activity level without any symptom.

The advantages of arthroscopic-assisted pull-out suture were to obtain the secure fixation for a small or comminuted avulsed fragment and to promote early rehabilitation. But it is technically demanding.

## Introduction

Most intercondylar eminence fractures of the tibia occur as the result of violent knee twisting, hyperflexion, hyperextension, or valgus-varus forces generated during motor vehicle or athletic accidents.

Meyers and McKeever<sup>7,8)</sup> classified these fractures into three types according to the displacement.

In the type I fracture there is minimum displacement of the avulsed fragment. The type II is a fracture with displacement of the anterior third to half of the avulsed fragment. Still the posterior portion is contact with the fracture site. In the type III fracture, avulsed fragment is completely separated from it.

The type III fractures are divided into type III A that the avulsed fragment is merely separated, and type III B that it is separated and rotated. Zaricznyj<sup>12)</sup> added type VI which the fragments are comminuted. Meyer and McKeever<sup>8)</sup> recommended the conservative treatment for type I and type II fractures, and the open reduction and the internal fixation for type III fracture. However the treatment of Type III has been controversial. Some authors prefer the conservative treatment<sup>9,10)</sup>.

Others are in favor of the open reduction<sup>1,7,8,12)</sup>. It has been reported that if the displaced fragment is not reduced completely, it may block mechanically knee extension permanently or result in the anterior instability. The operative arthroscopy provides an effective alternative to arthrotomy in the treatment of these fractures.

McLennan<sup>6)</sup> reported 35 these fractures treated with the arthroscopic reduction and maintained either cast immobilization or percutaneous pin fixation.

Loon<sup>5)</sup> described a case report treated with the arthroscopic fixation using the interfragmental compression technique.

The techniques of arthroscopic fixation with pulled-through polyester thread<sup>10)</sup>, multisuture<sup>2)</sup> and Link dynamic staple<sup>3)</sup> have been reported. However the operative technique is not established.

The purpose of this study is to demonstrate the effectiveness of the arthroscopic reduction and fixation in the treatment of the displaced fractures of the intercondylar eminence of the tibia, and to show the arthroscopic fixation techniques with pull-out sutures.

## Materials

Seven patients who had been treated with arthroscopic surgery for displaced fractures of intercondylar eminence of the tibia from September 1991 and January 1993 were reviewed.

One patient was a child and six were adults. Four patients were male and three were female. The age of patients at the time of operation was ranged from ten to fifty eight years old (mean 34.7 years old). The right knee was involved in five patients, and left was in two patients. Five patients had fresh fractures and two patients had displaced nonunions for six months in one patient and two years in another. Nonunions had cured after the conservative treatment with plaster cast immobilization for type III A fractures.

The causes of injuries were car accidents in five patients (the pedestrian injuries were in four patients, the falling off from a motorcycle in one patient), ski injuries were in two patients. On physical examination, all of the knees with the fresh fracture had limitation of full extension, hemarthrosis and positive Lachman test.

Two patients who had non-union complained of limitation of full extension and feeling of instability at the involved knee joint. Four of the seven patients had the following associated lesions. Two patients had the associated injury to medial collateral ligament, one patient had lateral collateral ligament rupture and fibular neck fracture, one patient had fracture of femoral shaft. If severe varus or valgus instability was noted on examination after fixation of fracture, surgical repair of collateral ligament was required through separated incision. One of the two patients with nonunion had the associated injury of severe medial collateral ligament to be reconstructed through separated incision and the other one had a healed fracture of ipsilateral femoral shaft. The others patients who had associated mild varus or valgus instability were conservatively treated for collateral ligament injury. Among the five patients with fresh injuries, three had type III A, two had type III B.

## Treatment

All of the seven fractures were reduced under arthroscopy. The reduction was maintained by arthroscopic-assisted pull-out suture.

Surgical Technique :

The 4.0 mm telescope with 30 degrees of angulation was introduced into the knee joint through an antero-lateral or antero-medial portal. In some cases, lateral midpatellar approach (Patel) provided better visual field for intercondylar area than anterolateral approach. It was necessary to excise the ligamentum mucosum and some portion of infrapatella fat pad in order to improve the arthroscopic visual field. Blood clots, fibrous tissues and the small osteochondral fragments were removed. The

anterior horn of lateral or medial meniscus might be interposed at the fracture site. It should be retracted with a probe.

Even though the avulsed fragments were completely separated from the fracture bed, it might be connected to the soft tissue around the fracture site with a thin bundle of the anterior cruciate ligament. The fractures might have comminuted fragments which had not been seen on radiographs. Most of the comminuted fragments were not separated from each

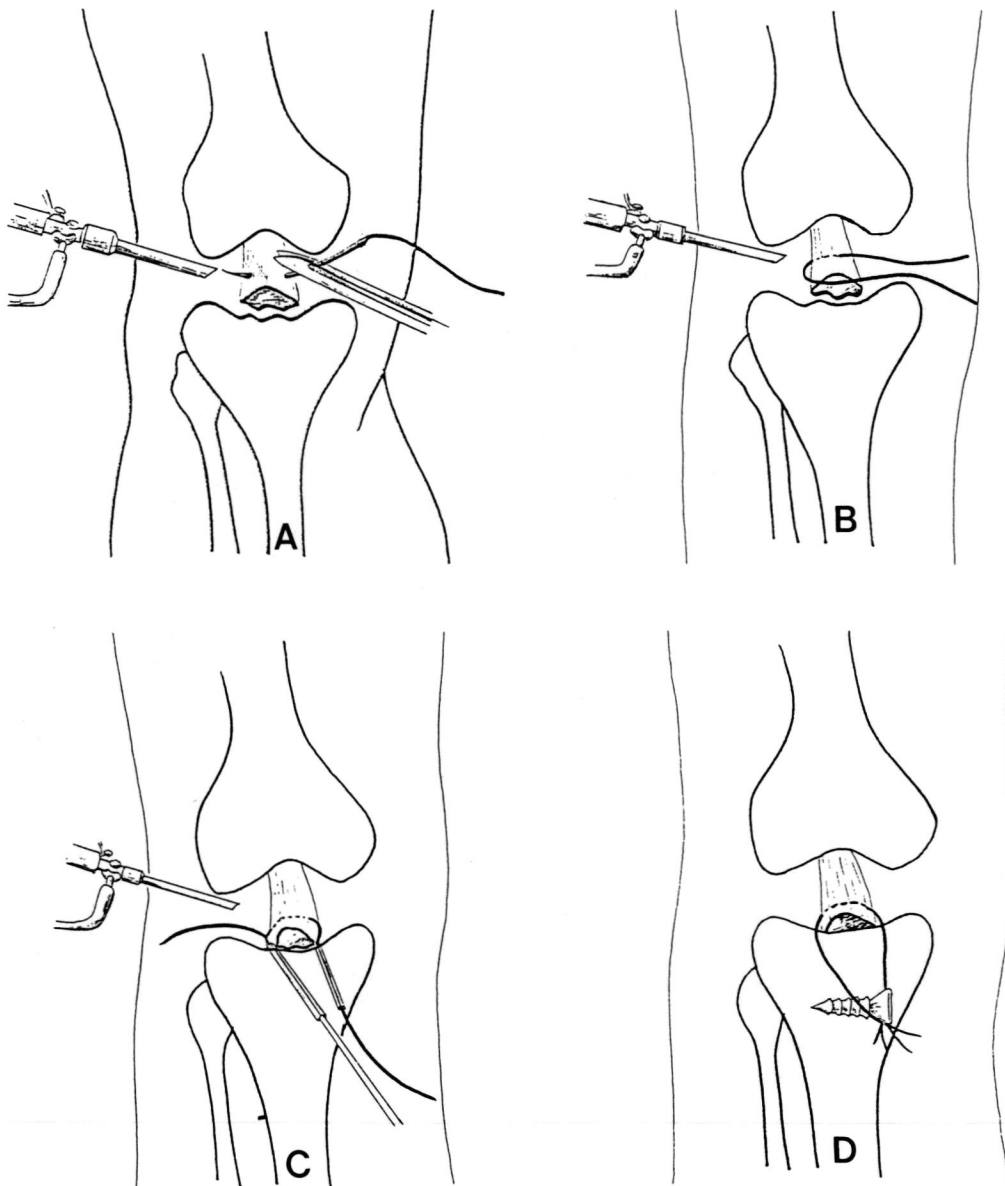


Fig. 1 Diagrammatic representation of the arthroscopic-assisted pull-out suture technique.

other because they were connected with the anterior cruciate ligament (Fig. 2-A).

After cleaning the fracture site, an ordinary needle with silk (No. 2 Vicryl) was put into the joint through anteromedial portal (Fig. 1-A).

The needle was passed the anterior cruciate ligament over the fragment, passed again the thin bundle of anterior cruciate ligament connecting the fracture fragment and around the soft tissue, then pulled out through anteromedial portal (Fig. 1-B, Fig. 2-B).

As the same manner, one more suture was placed. Two sutures were placed at the anterior cruciate ligament. A 3 cm vertical incision was made approximately 3 cm distal to the joint line on the anteromedial surface of the tibia. Two parallel holes were drilled obliquely from anteromedial proximal tibia to the crater of fracture site with the 2.4 mm guide

wire using Acufex guide system. Each end of the silk was pulled out through hole using Arthex suture retriever (Fig. 1-C, Fig. 2-C).

McLennan<sup>6)</sup> described that displaced fragments had been reduced with a probe. However in this series, the majority of displaced fragments could not be reduced into anatomic position with a probe, because it was impossible to correct the rotation of fragment by probing. But the rotation of avulsed fragment could be easily corrected by handling with a small towel clamps inserted through anteromedial portal instead of a probe. Two sutures were tied at the anchoring screw and washer inserted at the proximal tibia (Fig. 1-D, Fig. 2-D).

The stability of fixation was arthroscopically examined with the flexion and the extension of passive knee motion and probing.

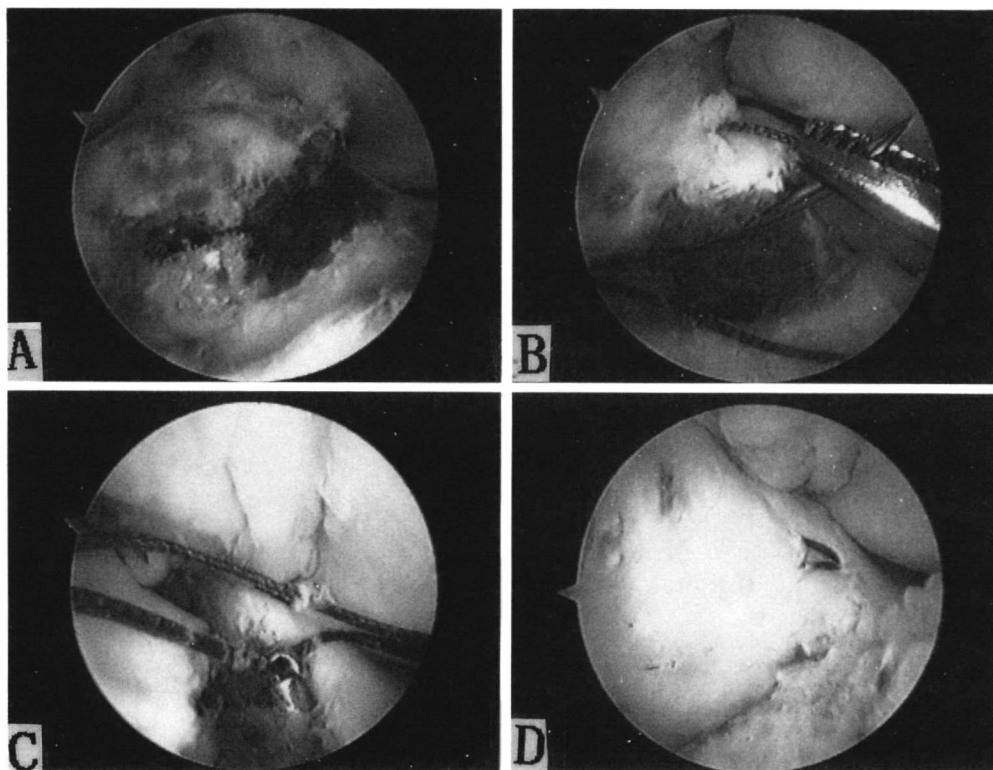


Fig. 2 Arthroscopic finding viewing through the lateral mid-patellar portal during the arthroscopic -assisted pull-out suture.

- A) The avulsed comminuted fragments are completely separated from the fracture bed and covered with the bundle of the anterior cruciate ligament.
- B) An ordinary needle with No. 2 Vicryl is put into joint through the antero-medial portal and passing the anterior cruciate ligament over the fragment.
- C) The end of silk is pulling out through the tibial hole with suture retriever.
- D) The fracture is perfectly reduced into the anatomic position and firmly fixed with the pull-out sutures.

When the displaced fragment is connected with around the soft tissue by some bundle of the anterior cruciate ligament, two transverse pull-out sutures were enough to fix the fracture securely.

However when the avulsed fragments were comminuted or had not intact some bundle between the fragment and the soft tissues around the fracture, transverse pull-out sutures might result in the fragment tilted anteriorly or posteriorly. In this circumstance, three parallel drill holes should be placed each other 120 degrees angle around the fracture bed and three sutures passed the anterior cruciate ligament over the fragment should be placed opposite to drill holes (Fig. 3). Three sutures placed around the fracture fragment were enough to prevent the tilt of the fragment.

It should be emphasized that varus-valgus stress test should be performed before and after arthroscopic fixation of fragment. If a severe medial or lateral ligamentous injury was noted on examination after fixation of the displaced avulsed fragment, it should be repaired through the separated incision.

#### Postoperative Care

After the arthroscopic reduction and fixation, the

knee was immobilized with long leg cast for 1 or 3 weeks depending on the stability of the fragment. Then limited motion brace was applied and knee motion was gradually increased.

## Results

No patient needed analgesics to relieve postoperative pain. The average of duration of hospitalization was five days.

The follow-up period ranged from fifteen months to thirty-one months with the mean of twenty months. All of seven fractures were radiologically united at the follow-up study. The average union time including non-union was twelve weeks. No patients had anterior instability tested with the clinical examination and K-T 1000 arthrometer except one patient who had asymptomatic plus 1 Lachmant test and 4 mm side-to-side difference.

All of the patients but one returned to normal life activity and preinjury sports activity level without any symptom. The only one patient who was a 45-year-old woman had the limitation of knee motion and showed patella baja on radiographs which seemed to be resulted from excessive excision of the infrapatellar fat to improve arthroscopic visual field. She was needed to perform arthroscopic adhesiolysis and manipulation to increase range of knee motion four months after the initial operation. Her knee motion increased to 125 degrees flexion after manipulation. She was only one patient who had limitation of sports activity.

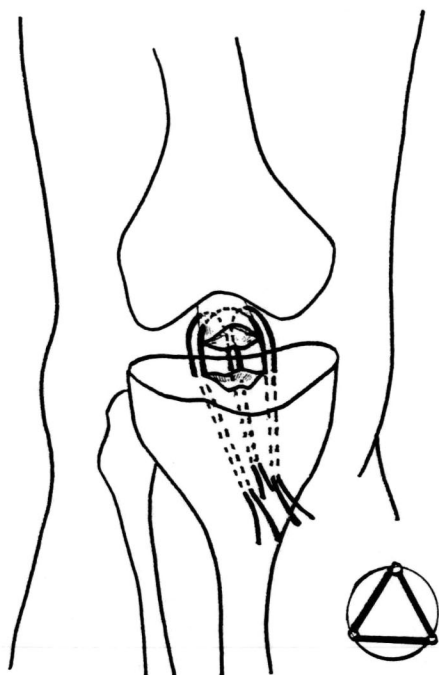
## Discussion

For the treatment of displaced fractures of intercondylar eminence of the tibia, arthroscopic surgery provides a new mode of treatment<sup>6)</sup>.

However a few reports about arthroscopic treatment for these fractures were published in English literatures<sup>2,5,6,10)</sup>. Arthroscopic surgical technique is quite complicated. It is very important to master arthroscopic skill for successful result in the treatment of these fractures.

If the arthroscopic field of the view is poor to see the fracture site through standard anterior approaches, the better field of the view could be obtained through lateral mid-patellar approach.

McLennan (1982)<sup>6)</sup> reported that reduction was considered satisfactory if there was less than two millimeters of offset. But the avulsed fragments can



**Fig. 3 :** Diagrammatic representation of arthroscopic-assisted fixation with three pull-out sutures passed through three parallel tibial drill holes.



be arthroscopically reduced into a perfect anatomic position by handling with towel clamps instead of probing

Arthroscopic percutaneous pinning had the advantage to fix fragment easily. The disadvantage is that it is difficult to fix a small or comminuted avulsed fragments.

Arthroscopic fixation with screw using AO/ASIF principle of interfragment compression<sup>5)</sup> had the advantages of rigid fixation and early mobilization. But it can not fix a small fragment firmly.

On the other hand the advantage and disadvantage of arthroscopic -assisted pull-out suture are vice versa with those of percutaneous pin fixation. Especially arthroscopic suture with a needle is technically demanding. An easier arthroscopic suture technique is that a 18 gauge spinal needle is inserted into the knee joint percutaneously and passed the anterior cruciate ligament just above the fragment, then #1 PDS is introduced into the hole of spinal needle to suture the anterior cruciate ligament. Berg<sup>2)</sup> reported the cases of failure after arthroscopic multisture for the treatment of these comminuted fractures. In the study, it has been found that the arthroscopic-assisted transverse pull-out suture passed through two parallel tibial holes is very effective to fix a fragment with some bundle connecting the soft tissue around the fracture site. But it may result in tilting of fragment anteriorly or posteriorly in the comminuted or completely separated avulsed these fractures. For that situation, three sutures passed three parallel tibial holes around the crater of fracture site are required to fix the fractures securely (Fig. 3).

It has been reported that in children drilling across the tibial physis does not cause any growth disturbance<sup>4)</sup>. In this series authors were careful not to damage the tibial physis in children.

The fracture of intercondylar eminence of the tibia in adult with the ligamentous injury usually has an unsatisfactory results<sup>8)</sup>. In this series, three patients had associated collateral ligament lesions. One of the two medial collateral ligament ruptures required the surgical treatment through the separated incision. But others associated with varus and valgus instability were treated by conservative method because the instability was significantly decreased after the fixation of fracture.

Baxter and Wiley (1988)<sup>1)</sup> have reported that although no patient complained of any subjective feeling of knee instability, 51% of patients had a positive anterior drawer test. However in this series, only one patient had 1+ positive Lachman test on

examination at follow up, even though the patient was asymptomatic. And no patient had more than 10 degrees of loss of extension, because the fractures were perfectly reduced into the anatomic position arthroscopically and the knees were immobilize the knee in extension for as short period as possible.

In the treatment of fracture of the intercondylar eminence of the tibia, arthroscopic surgery provides anatomic reduction and rigid fixation, assesses possible associated lesion accurately, promotes early rehabilitation and minimizes morbidity.

## Conclusion

Arthroscopic reduction and pull-out suture are an effective treatment for displaced fracture of the intercondylar eminence of the tibia.

Arthroscopic-assisted pull-out suture provides a secure fixation for small or comminuted avulsed fragments, promotes early rehabilitation and minimize morbidity.

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# Osteochondral Fracture of the Talar Dome

## Evaluation of Clinical Features and Results of Arthroscopic Treatment

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### ●Key words

Osteochondritis dissecans, Osteochondral fracture, Talus, Arthroscopy

### ●Abstract

We reviewed osteochondral fracture and/or osteochondritis dissecans of the talar dome of 15 ankles in 15 patients who underwent surgical treatment at Seoul National University Hospital from Jan. 1987 to Dec. 1992. Twelve were males and 3 were females. The mean age at the operation was 26 years (range, 17-44 years). The mean follow up period was 20 months (range, 12-54 months). All the 15 patients had history of conservative treatment including physical therapy and medication under the diagnosis of ankle sprain, and the mean period of conservative treatment was 10.4 week (range, 4-16 weeks). Twelve of 15 patients (80%) had definite history of trauma; 8 of 11 medial lesions (73%) and 4 of 4 lateral lesions (100%).

We could almost confirm the osteochondral fracture with simple X-ray. Bone scan was performed in 6 ankles, and CT or MRI, in 10 ankles. The location of the lesion was on medial aspect of the talus in 11 ankles and lateral, in 4 ankles.

Arthroscopic excision, curettage, and/or drilling were performed in 11 ankles, while arthrotomy was performed for the remaining 4 patients. At the latest follow up, 10 of 11 ankles treated with arthroscopic procedure had excellent or good results and 1, fair. In contrast, 4 opened ankles had 1 excellent, 2 fair and 1 poor results which needed second operation for loose body removal. Postoperatively ankle of arthroscopic procedure had only transient paresthesia and there was no serious complication. Ankle arthroscopy showed definite role in diagnosis and treatment of osteochondral fracture. The duration of hospitalization was short and postoperative rehabilitation was rapid. The clinical results were satisfactory.

As we supposed that the principal etiology of osteochondral fracture of the talus would be trauma, possibilities of osteochondral fracture should be considered in every sprained ankle. In our series, the surgical treatment of osteochondral fracture, even in the chronic lesions, yielded good results.

### Acknowledgement

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## I Introduction

The naming of the transchondral fracture of the talar dome has been controversial upto mainly due to lack of universal acceptance on the common etiology. Basically same lesions have been referred as many nomenclatures, including osteochondritis dissecans, or one of the names those describe the fracture pattern : transchondral fracture, osteochondral fracture, dome fracture of talus, flake fracture, or chip fracture of the talus.

Historically many authors who used the term "osteochondritis dissecans" have believed that the lesion of the talus is histologically spontaneous necrosis of subcortical bone deprived of vascular supply<sup>5)</sup>. They suggested constitutional, humoral and hereditary ones as the possible factors of the lesion. In contrast, the others including Berndt and Harty, proposed trauma is the most important factor. Berndt and Harty<sup>2)</sup> established the concept of the trauma as the principal etiologic factor of osteochondritis dissecans. They reproduced the lesions in cadevaric experiment those found in the ankles underwent external violence. The treatment of osteochondral fracture of the talus has encompassed the two streams, conservative and operative. Many reports has shown better results with the operative modalities even in the chronic cases<sup>1,3,4,12,14)</sup>. Recently arthroscopic surgery has been used more and more with shorter hospital stay and less complications.

The purpose of this report is to review our experience with osteochondral fracture of the talar dome in 15 ankles of 15 patients who underwent surgical treatment at Seoul National University Hospital from Jan. 1987 to Dec. 1992.

## II Materials & Methods

Fifteen ankles of 15 patients with osteochondral fractures of the talar dome were diagnosed and treated at Seoul National University Hospital from Jan. 1987 to Dec. 1992. The initial diagnosis was osteochondritis dissecans or osteochondral fracture of the talar dome. The 15 patients included 12 males and 3 females, and right ankles in 11 and left in 4. The age of patient ranged from 17 to 44 years (average, 26 years). Follow-up period ranged from 1 year to 4 year 6 months (average, 1 year and 8 months).

Before visit on our hospital, all of the 15 patients had been diagnosed as ankle sprain and treated with

conservative methods, including rest, physical therapy, NSAIDs and cast immobilization. The duration of conservative treatment was ranged from 4 weeks to 16 (average, 10.4 weeks).

All of the patients complained pain. Other clinical findings included tenderness, swelling, click, limitation of motion and lateral instability.

The diagnosis was made with only simple X-ray in 5 ankles (Fig. 1) and in the 10 ankles, more sophisticated studies, including scintigram and CT or MRI (Fig. 2, 3) were used for accurate diagnosis and evaluation of the location and stability of the lesions. The lesions were classified according to the stages described by Berndt & Harty (Table 1). There were 11 medial lesions and 4 lateral lesions. History of trauma was identified in the 12 ankles (80%) ; 8 of 11 medial lesions (73%), and 4 of 4 lateral lesions (100%). The mechanisms of injury included inversion, planar flexion and eversion. In 5 ankles there was no specific injury mechanism identified. Eversion force was found in 1 medial lesion and the inversion force in 4 medial and 2 lateral lesions (Table 2).

The mean time lapsed from the onset of symptoms to surgical treatment was 3 year 3 months (range, 3

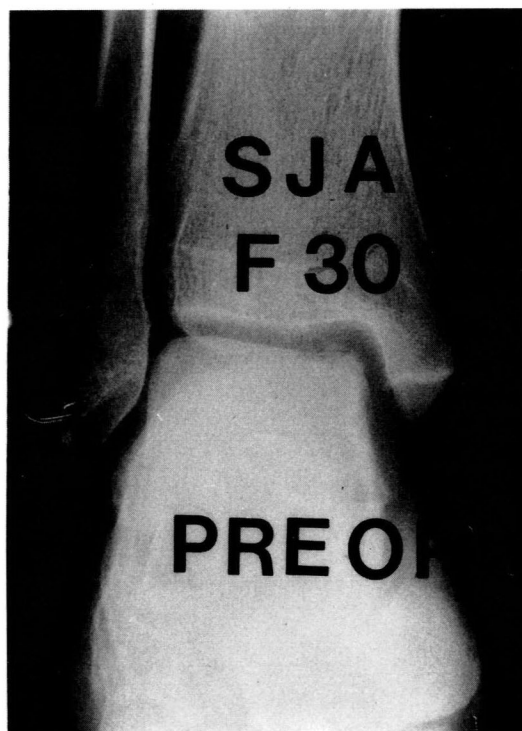


Figure 1 Simple X-ray showed osteochondral fragment on the talar dome without displacement.

Table 1 Stage (Berndt &amp; Harty classification)

	stage I	stage II/III	stage IV	total
Medial	0	10	1	11
Lateral	0	2	2	4
Total	0	12	3	15

Table 2 Injury mechanism

	INV	INV+PF	EV	Unknown	Total
Medial	1	3	1	3	8
Lateral	2	0	0	2	4
Total	3	3	1	5	12

(INV = inversion, PF = plantar flexion, EV = eversion)

months-3 years 3 months). Surgical treatment was performed by open arthrotomy 4 ankles before Sep. 1988. After Oct. 1988, arthroscopic surgery had been done in 11 ankles. In the lesions of grade II or III, surgical procedures consisted of excision of fragment, curettage and abrasion of subchondral bed, resulting fresh bleeding from the bed. In grade IV lesions, loose body removal was followed by curettage and abrasion.

In 4 cases of open arthrotomy, 2 medial lesions needed transmalleolar approach to obtain sufficient visual field, and in 1 medial and 1 lateral lesion, posteromedial or anterolateral approach was used respectively. Full weight bearing was not allowed until 3 month postoperatively. In doing arthroscopic surgery, anterolateral, anterolateral and antero-central portals were used. Temporal pin through calcaneus was needed for distraction of tight joint space

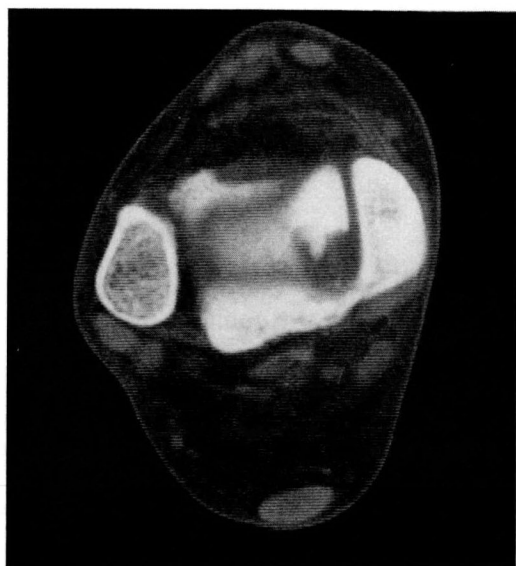


Figure 2 CT showed crater on the talus with osteochondral fragment.



Figure 3 MRI in T1 weighted image showed osteochondral fracture in posterior aspect of talus without displacement.

Table 3 Assessment System

## Subjective assessment

- Excellent : completely symptom free  
 Good : occational pain on prolonged weight - bearing  
 Poor : no changes or more symptomatic

## Objective assessment

- Excellent : negative physical and radiological finding  
 Good : nontender swelling with normal radiograph  
 Fair : negative clinical signs with abnormal radiograph  
 Poor : painful motion and tenderness

## Overall assessment

- Excellent : excellent subjectively and objectively  
 Good : one excellent the other good or both good  
 Fair : good subjectively and fair objectively  
 Poor : poor subjectively and/or objectively

(modified Parisien JS, CORR, 1985)

Table 4 Follow Up Results (Overall assessment)

	Arthrotomy	Arthroscopy	Total
Excellent	1	6	7
Good	2	4	6
Fair	0	1	1
Poor	1	0	1
Total	4	11	15

Table 5 Operation Time &amp; Hospitalization

	Arthrotomy	Arthroscopy
Op. time	125 - 140 min	50 - 70 min
(mean)	( 130 min )	( 59 min )
Hospitalization	7 - 8 days	4 -5 days
(mean)	( 8 days )	( 4.4 days )

in all cases. Postoperatively partial weight bearing with crutch was allowed from the third day and full weight bearing was allowed as soon as possible if patient tolerated. The postoperative results were assessed both subjectively and objectively according to our modification of the criteria made by Parisien, and the sum of both subjective and objective results were classified to excellent, good, fair and poor (Table 3, 4).

### III Results

The mean time of operation in the cases of arthrotomy and arthroscopic procedures were 130 minutes (range, 125-140 min.) and 59 minutes (range, 50-70 min.) respectively (Table 5). The mean duration of hospital stay was 8 days (range, 6-9 days) in the cases of open arthrotomy and 4.4 days (range, 3-5 days) in arthroscopic surgery. In the 4 cases of open arthrotomy, excellent results were obtained in 1 ankle and good results, in 2 ankles (Table 4). One ankle of open arthrotomy needed

second operation due to persistent symptoms and assessed as poor. In arthroscopic cases, excellent result was obtained in 6 of 11 ankles (54%), good in 4 (37%) and fair in 1 (9%). There was no poor result. Only transient numbness on dorsum of the foot was found in 1 ankle after arthroscopic procedure and the symptom disappeared within 6 months. There was no persistent serious complication found in the follow up.

#### IV Discussion

The osteochondral lesions of the talar dome has been reported by many authors with various nomenclature, as osteochondritis dissecans, transchondral fracture, osteochondral fracture, flake fracture and fracture of talar dome<sup>1,2,4,5,6,7,9,11,12)</sup>. It must be because of lack of universal acceptance on the etiology of the lesion. The descriptions using osteochondritis dissecans usually implies avascular necrosis as the primary etiology and trauma, humoral, constitutional and hereditary factors contribute to the lesion. In contrast, the most authors described the lesion as fracture, insisted that the trauma is the major factor of the lesion<sup>1,2,4,6,7,11,14)</sup>. Historically, Monro in 1856, reported the osteochondral loose body in the ankle, and he assessed the lesion from trauma but not classified it as fracture. Koenig, in 1888, is recognized as being the first to use the term osteochondritis dissecans to describe the pathological process of loosed bodies in the knee joint. He theorized without substantiation, that loose bodies were the result of "spontaneous necrosis" secondary to occlusion of small end arteries supplying the area. Kappis, in 1992, reported similar lesions in ankle. The concept that such lesions could represent traumatic intra-articular fracture was first advanced by Rendu in 1932, and Fairbanks regarded trauma as the cause of the subchondral bone with a resultant avascular necrosis. In 1959, Berndt & Harty<sup>2)</sup> established the concept of trauma as the principal etiologic factor of osteochondritis dissecans. They described the lesion as transchondral fracture, by analysis of previous reports and their cases. They represented in the cadaveric study the both medial and lateral lesions according to the mechanical forces. They assessed the lesion as fracture of articular surface of a bone, produced by force transmitted from articular surface of the contiguous bone, through articular cartilage to subchondral bone, results in compression of trabeculae and avulsion of osteochondral flake. It might be caused

by tribial traumas and the symptoms exaggerated by more painful soft tissue injury. But in the patients with multiple involvement of joints other than ankle, and cases with familial or hereditary involvement the lesion can not be explained only with trauma as the prime etiology. Kelikian in 1985, and Chen, in 1992<sup>5)</sup>, classified the osteochondral lesions into two categories of subchondral fracture by traumatic origin and osteochondritis with possible factors of constitutional, humoral, vascular and hereditary factors. As in the review of the previous reports, the larger stream about debates on the etiology of the osteochondral lesions of the talus is trauma as the prime factor for the lesion, and in addition the only representation was possible in the Berndt & Harty's experiment. The results were trauma could provoke the both medial and lateral lesions with tightening of the joint space by inversion and the resultant lesions were same as those reported by others. In addition, other than major traumas those easily recalled by the patient, minor or tribial traumas could possibly exist or neglected by both patient and physician. In our cases, 12 of 15 ankles (80%) were associated with trauma, especially all of the 4 lateral lesions. There was no familial involvement in all the patients and no joints other than ankle were involved. So, we could suggest the trauma as the major factor for both medial and lateral lesions in the talus. The symptoms of the osteochondral fracture are various according to the cases. The mis-diagnosis was made as sprain of the ankle in many cases and patients were treated under the impression of sprain. Russel, in 1955, reported separation of the cortical bone in 6.75% in his 133 patients with ankle sprain. Anderson, in 1954, reported 6 cases of concomitant osteochondral fractures among 27 sprains. In our cases all of the patients were diagnosed initially as sprain. In addition many reports have proved even minor traumas, if repeated, could progress the lesion up to higher stages and exaggerate the symptom<sup>2,7,11,13)</sup>. We thought, in all of the sprains with chronic process without improvement of the symptom, the possibility of combined osteochondral fracture should be suspected, and earlier and more sophisticated diagnostic modalities should be tried for accurate diagnosis and earlier treatment.

In many cases the simple radiologic studies can not confirmed the osteochondral lesion especially in the stage I. The scintigram can be useful in the assessment of presence of the lesion and many authors have recommended tomogram or MRI for accurate diagnosis and staging<sup>1,4,8,15)</sup>. Nelson & De-

paola, in 1990<sup>10)</sup>, recommended MRI in differentiation between the stage II and III lesions by signals from the synovial fluid in spaces between the osteochondral fragment and base.

In the treatment of osteochondral fracture of talar dome, conservative and operative modalities have been adopted. Conservative treatment includes rest, physical therapy, support stocking, bandage, elastic strap, cast. Flick & Gould<sup>7)</sup> reported poor results in 75% with conservative treatment, and Berndt & Harty analyzed results prior to 1958. They reported poor results in 74% with conservative treatment and fair in 9% and only good results were obtained in 17%. Furthermore, good results could be obtained with 4 months of immobilization. Davidson reported in 14 cases of his, 71% was assessed as poor with conservative treatment. The immobilization period needed to obtain improvement of symptoms were 16 weeks from Berndt & Harty's report and 4 to 8 weeks from Davidson's, 18 weeks from Candale & Belding's<sup>4)</sup>. In contrast, with surgical intervention, Flick & Gould could achieve 79% of excellent to good results, without poor result. Berndt & Harty<sup>2)</sup> reported that in the 56 ankles underwent surgical intervention, 79% of patients showed excellent or good result. We assessed the results of conservative treatment prior to surgery as poor due to persistent symptoms: pain, swelling on walking or tenderness. In the 4 ankles underwent open arthrotomic surgery, excellent or good results according to modified Parisien's criteria were obtained in 75% of cases, and in arthroscopic surgery excellent result was obtained 6 of 11 ankles (54%), and good in 4 (37%) and fair was 1 (9%) with no poor result. Only one ankle underwent arthrotomy was assessed as poor due to persistent pain.

In comparison between the two procedures, open arthrotomy needed longer operation time and hospital stay. Furthermore even partial weight bearing was not allowed until 3 to 6 weeks. In contrast, arthroscopic procedures could allow the operation within one tourniquet time (usually 90 minutes) in all cases and earlier discharge and less immobilization. Even if the difficulties of arthroscopy in ankle should be overcome, the arthroscopic surgery in ankle must produce prior result to open arthrotomy and the arthroscopic surgery will play a definite role in both diagnosis and treatment.

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# Baseball Player's Elbow in Adolescents

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## ●Key words

Baseball, Elbow, Adolescents

## ●Abstract

We surveyed the 114 baseball players of junior high & high school in Taegu in order to evaluate the prevalence of symptoms and radiographic findings of the elbow and correlation of these findings to career & position of the baseball game.

The results were as follows.

1. Of 114 players, 83 were non-pitchers and 31 were pitchers. The mean career was 3.8 years (7 months to 6 years).
2. The 77 players (67.7%) had the pain on their elbow during or after daily exercise. Other clinical symptoms were locking (30.7%), limitation of motion (18.4%), swelling (16.6%) and clicks on motion (10.5%).
3. On the radiogram of the elbow, hypertrophy or separation of medial epicondyle were seen in 34% of players, loose body in 17%, hypertrophy of the humerus in 12% and cystic change of the capitellum in 11%.
4. The mean career of symptomatic players was 4.4 years but the non-symptomatics was 2.7 years. The mean career of players who had abnormal radiographic findings was 5.1 years but 3.1 years in players who had no abnormal radiographic findings.
5. The symptoms and radiographic changes were more common in the elbow of pitchers, group due to throwing frequency & pitching type.
6. Among the 77 players who had any kinds of problem of the elbow, 49 players had no experience of visiting hospitals.
7. To prevent these injuries of the elbow, the following recommendations were made : restrict the number of innings pitched per game, abolish the curve ball throwing in this age group, ensure an adequate warm up period before exercise or games and inform the parents and coaches of possible harmful nature of excessive throwing.

The elbow is the most frequent area of complaint in children and adolescent baseball players. The physical stresses associated with repetitive throwing create extra-ordinary forces, which may affect the normal osteochondral and soft tissue developmental process and are the important factors causing the decrease of competitive power and shortening of life as a baseball player in adolescents.

We surveyed the 114 baseball players of junior high & high school in Taegu City in order to evaluate the prevalence of symptoms and radiographic findings of the elbow and correlations of these findings to career and position of the baseball.

## Materials and Methods

We had the history taking, physical examination and radiographic study for 83 non-pitchers and 31 pitchers of the baseball players in adolescents between May 1994 and August 1994.

The age distribution were from 12 to 17 mean 14.4 years (Table 1). The careers as a baseball player were 7 months to 6 years, mean 3.8 years (Table 2). The throwing styles were 104 cases (91.2%) in overhand, the most common style, 4 cases in three-quarters and 6 cases in under-throw (Table 3). The frequencies of throwing were 150 times a day in pitchers group, 100 times a day in non-pitchers group. The ratio of the pitching type in pitchers was 70% in hard, fast ball, and 30% in breaking ball (curve ball).

**Table 1. Age Distribution**

Age (yrs.)	No. of Cases (%)
11	8 (4.0%)
12	8 (4.0%)
13	14 (12.3%)
14	24 (21.1%)
15	18 (15.8%)
16	24 (21.1%)
17	18 (15.8%)
Total	114 (100.0%)

**Table 2. Careers in Baseball**

Years	No. of Cases (%)
Under 1	17 (15.0%)
1 ~ 3	43 (37.8%)
3 ~ 5	39 (34.2%)
Over 5	15 (13.1%)
Total	114 (100.0%)

**Table 3. Throwing Style**

Style	Pitchers Group (%)	Non-pitchers Group (%)	Total (%)
Overhand	21 (67.7%)	83 (100.0%)	104 (91.2%)
Three-quarter	4 (13.0%)	0	4 (3.5%)
Under-throw	6 (19.3%)	0	6 (5.3%)
Total	31	83	114

## Results

### 1. Clinical findings

The 77 players (67.5%) had the pain on their elbow during and after daily exercise and other clinical symptoms were locking (35 cases), limitation of motion (21 cases), swelling (19 cases) and click on motion (12 cases) (Table 4, 5).

The elbow flexion contracture existed in 21 cases (15.4%). In the pitchers group 9 cases were under 10°, 3 cases over 10°, and the non-pitchers group, 6 cases were under 10°, 3 cases over 10°. Therefore the elbow flexion contracture was more common in the pitchers group (Table 6).

We compared the bilateral elbows and checked the carrying angle. The nine cases had the differences in the carrying angle and the differences were under 10° (Table 7).

### 2. Radiographic findings

We checked the radiogram of the bilateral elbows in antero-posterior and lateral view. The hypertrophies or separation of medial epicondyle were seen in 17 cases (55%) in the pitchers group, 22 cases (26%) in the non-pitchers group. The loose bodies were seen in 8 cases (26%) in the pitchers, 11 cases (13%) in the non-pitchers. The cystic changes of capitellum were seen in 6 cases (20%) in the pitchers group, 7 cases (8.4%) in the non-pitchers group. The hypertrophies of humerus were seen in 9 cases in the pitchers group, 5 cases in the non-pitchers group. The fragmentation of olecranon tip were seen in 12 cases, the overgrowth of radial head were seen in 12 cases, the premature epiphyseal fusions were seen in 6 cases and the calcifications on ulnar collateral ligament in 5 cases. Therefore these radiographic findings were more common and prominent in the pitchers group (Table 8, Fig. 1, 2, 3, 4).

### 3. Relations of symptoms and age & career

The mean age whose had the symptoms was 14.2 years and mean careers who had the symptoms were

**Table 4. Clinical Symptoms**

Clinical Symptoms	No.	(%)
Pain	77	67.5%
Locking	35	30.7%
Limitation of Motion	21	18.4%
Swelling	19	16.6%
Clicks on Motion	12	10.5%

3.8 years in the pitchers group, and mean age 15.1 years & mean career 4.8 years in the non-pitchers group. The pitchers group have complained of the symptom in the younger age & career than the non-pitchers group. And the mean careers of the players with symptom was 4.4 years, without symptoms 2.7 years (Table 9).

4. Relations of abnormal radiographic findings and

**Table 5. Pain on Elbow**

Pain	Pitchers Group (%)	Non-pitchers Group (%)	Total (%)
Absent	4 (12.9%)	33 (39.7%)	37 (32.5%)
Present	27 (87.1%)	50 (60.3%)	77 (67.5%)
Total	31	83	114

**Table 6. Flexion Contracture**

Flexion Contracture (degree)	Pitchers Group (%)	Non-pitchers Group (%)	Total (%)
Absent	19 (61.3%)	74 (89.2%)	93 (81.6%)
<10	9 (29.0%)	6 ( 7.2%)	15 (13.1%)
>10	3 ( 9.7%)	3 ( 3.6%)	6 ( 5.3%)
Total	31	83	114

**Table 7. Cubitus Valgus Deformity**

Difference in Carrying Angle	Pitchers Group (%)	Non-pitchers Group (%)	Total (%)
Absent	28 (90.3%)	77 (92.8%)	105 (93.0%)
Present	3 ( 9.7%)	6 ( 7.2%)	9 ( 7.0%)
Total	31	83	114

**Table 8. Radiographic Findings**

Findings	Pitchers Group (%)	Non-pitchers Group (%)	Total (%)
Hypertrophy or separation of medial epicondyle	17 (55%)	22 (26%)	39 (34%)
Loose body	8 (26%)	11 (13%)	19 (17%)
Cystic change of capitellum	6 (20%)	7 (8.4%)	13 (11%)
Hypertrophy of humerus	9 (29%)	5 ( 6%)	14 (12%)
Radial head overgrowth	7 (23%)	5 ( 6%)	12 (11%)
Olecranon tip fragmentation	5 (16%)	7 ( 8%)	12 (11%)
Premature epiphyseal fusion	3 ( 9%)	3 (3.6%)	6 ( 5%)
Calcification on UCL	3 ( 9%)	2 (2.4%)	5 (4.4%)



Fig. 1. The hypertrophy and mild separation of the medial epicondyle is seen.



Fig. 2. The hypertrophy and separation of the medial epicondyle, cystic change of the capitellum and overgrowth of the radial head.

Table 9. Relations of Symptoms and Age &amp; Career

Pain		Pitchers	Non-pitchers
Present	No.	27	50
	mean age (yrs.)	14.2	15.1
	mean career (yrs.)	3.8	4.8
Absent	No.	4	33
	mean age (yrs.)	13.2	14.1
	mean career (yrs.)	1.8	2.9



Fig. 3. The osteochondritis dissecans and loose body.



Fig. 4. The avulsed fragment of the olecranon.

Table 10. Relations of Abnormal Radiographic Findings and Age &amp; Career

finding		Pitchers	Non-pitchers
Present	No.	19	39
	mean age (yrs.)	14.9	15.5
	mean career (yrs.)	4.7	5.1
Absent	No.	12	44
	mean age (yrs.)	12.6	13.9
	mean career (yrs.)	2.2	3.1

Table 11. Treatment of Symptomatic Players

Visit to Hospital		Pitchers Group (%)	Non-pitchers Group (%)	Total (%)
No		20 (74%)	29 (58%)	49 (63.6%)
Yes	Conservative	5 (18.5%)	20 (40%)	25 (32.5%)
	Operation	2 (7.5%)	1 (2%)	3 (3.9%)
Total		27	50	77

age & career

In the pitchers group the mean age whose had the abnormal radiographic findings was 14.9 years, the mean career was 4.7 years, and in the non-pitchers group 15.5 years, 5.2 years respectively. We observed these abnormal radiographic findings appeared in the younger age & career in the pitchers group than the non-pitchers group. The mean career who had the abnormal radiographic findings was 5.1 years, but with normal radiographic finding 3.1 years (Table 10).

#### 5. Treatment of symptomatic players

Among 77 players who had any kinds of the elbow symptoms, 49 players had not visited the hospital, and only 28 players (36.4%) visited the hospital and had conservative & surgical treatments (Table 11).

## Discussion

The elbow is the most frequent area of complaint in children and adolescent baseball players. The physical stresses associated with repetitive throwing create extra-ordinary forces, e.g. compression, shear and distraction, on the medial, lateral, anterior and posterior aspects of the elbow joint which may result in variations of the normal osteochondral developmental process<sup>1,9)</sup>. The ossification centers around the elbow appear at the capitellum at about 2 years and total 6 ossification centers appear and

these centers are fused at from 16 to 18 years, respectively. Therefore elbow injuries in growing adolescents could cause the permanent deformity of the elbow due to epiphyseal plate injuries.

The throwing motion is divided into four general phases of motion : initial stance, wind-up, forward motion of arm and follow-through. Most of the injuries occur in 3rd or 4th phase<sup>4)</sup>, Tullos and King<sup>3)</sup> have divided the throwing motion into cocking phase, acceleration phase and follow-through phase for an average overband fast ball. In the cocking phase and early of the acceleration which the hand and forearm grasping ball is located behind the arm, then the ball is taken off. The rapid pronation of the forearm and extension occurs through the early phase of follow-through. Slocum<sup>10)</sup> classified the throwing injuries of the elbow into medial tension overload, lateral compression injury and extension overload. These excessive forces to the elbow joint in each phases cause the various lesions<sup>1, 4, 8, 9, 13, 14, 15)</sup>.

These various injuries resulted in the more serious elbow deformities in the growing pitchers in adolescents throwing the hard, fast ball and breaking ball. The elbow injuries of the baseball players in adolescence have the clinical symptoms of pain, locking, limitation of motion, swelling and click on motion.

Larson et al<sup>5)</sup> reported in the adiescent baseball pitchers the pain of elbow joint was 20%, the flexion contracture of elbow was 10% and the cubitus val-

gus was 3%. And Gugenheim et al<sup>5)</sup> reported the pain of elbow joint was 17%, the flexion contracture of elbow was 10% and the cubitus valgus was 37%. We observed in the pitchers group the pain of elbow joint was 87.1%, the flexion contracture of elbow was 38.7% and the cubitus valgus was 9.7%, and in the non-pitchers group the pain of elbow was 60.3%, the flexion contracture of elbow was 10.8% and the cubitus valgus was 7.2%.

The radiographic changes are hypertrophy separation and fragmentation of the medial epicondyle of the humerus, loose body, osteochondritis dissecans<sup>4, 8, 9, 15)</sup>. We observed that hypertrophy and separation of medial epicondyle which was most common changes were 39 cases (34%) and others were loose body (17%), cystic change of capitellum (11%), hypertrophy of humerus (12%), radial head overgrowth (11%), fragmentation of olecranon tip (11%), premature epiphyseal fusion (5%) and calcification on ulnar collateral ligament (4.4%). And these lesions were more common in the pitchers group than the non-pitchers group.

The clinical symptoms and abnormal radiographic findings were significantly different according to the age, the career and the positions of the players. In the pitchers group the elbow pain was complained at 14.2 years of the mean age. 3.8 years in the mean career and in the non-pitchers group the mean age was 15.1 years, the mean career 4.8 years.

About the abnormal radiographic findings, in the pitchers group mean age was 14.9 years, mean career was 4.9 years, and in the non-pitchers group mean age was 15.5 years, mean career 5.2 years. We observed that these abnormal findings appeared in the younger age and career than the normal symptoms and radiographic findings. We think that the reason for the more common finding in pitchers group are repetitive stress and intense forces due to the more frequent pitching of the hard, fast ball and breaking ball. The catchers throw as many balls as pitchers in the game, but they didn't show no significant difference compared with the other players of non-pitchers' group because of less throwing of hard, fast balls and breaking balls.

The treatment is various. In the absence of the loose body conservative treatments e. g. restriction of throwing, hot pack and anti-inflammatory drugs are indicated and in the presence of the loose body removal of loose body is indicated<sup>1, 8, 15)</sup>. The curettage, trimming and multiple drilling of the crater can be indicated<sup>1, 12, 15)</sup>.

Among the 77 players who had any kinds of problems of the elbow, 49 players had no experience of

visiting hospitals. We think that the reasons for less visit to the hospitals are due to the problem of the course in life of the baseball players in our country. That is, especially in the pitchers group the overstrained elbow resulted from the unrestricted pitching and breaking ball in practice and game will have a bad effect to their course of baseball life. The various social factors cause the lack of ability as the baseball player and the lack of ability as an ordinary social man performing daily life are considered as a major factor for not visiting the hospitals. The elbow lesions of the baseball players in adolescence should not be considered as a mild injury like an adult and careful examination and treatment should be considered and coaches and parents should be informed. We think that the prevention is more important than the treatment in these injuries of the baseball players in adolescence.

Therefore we have made the following recommendation to prevent these injuries of the elbow : ensure an adequate warm-up period before exercise or games, restrict the number of innings pitched per game, abolish breaking ball throwing in this age group, adequate rest after throwing, inform parents and coaches of the possible harmful nature of excessive throwing and prepare the various social factors for the long life as a player.

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# Measurement of the 3-dimensional Momentum of the Knee Joint Using the New Electrogoniometer

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## ●Key words

3-dimensional movements of the Knee, Electrogoniometer

## ●Abstract

The movements of the knee joint are very intimately influenced by the movement of other joints of the leg. The functional interpretations of the movement of the knee joint are very important, recognized as practical problems, and there are a lot of difficulties in measuring the movements of the knee joint accurately, especially when there is instability of the knee joint. Many researches have been made to measure the 3-dimensional movements of the knee joint quantitatively and high speed stereo photographic method, video camera method, method using the accelerator, electro-optical method and methods using the exoskeletal link system are introduced so far. However, these methods are so complicated and have shortcomings that there is no way to correct the errors. So we performed this research to develop a new electrogoniometer which is easy to correct the errors and simple in design. The new instrument used in this research is composed of two universal joints and a pin joint between them, and 6 electrogoniometers are applied to measure the relative 3-dimensional positions of the moving tibia compared with fixed femur. The results were as follows.

The amount of knee motion on flexion/extension plane were ranged from the minimum of  $39.89^{\circ}$  to maximum of  $80.04^{\circ}$  and the mean value was  $55.37^{\circ}$ . The amount of rotation were ranged from  $9.21^{\circ}$  to  $18.09^{\circ}$  mean value was  $13.22^{\circ}$ . The amount of knee motion on adduction/abduction were from  $7.84^{\circ}$  to  $15.91^{\circ}$ , mean value was  $11.55^{\circ}$ .

## Introduction

Movements of knee joints are greatly influenced by the relative movements of other joints in the legs. The functional interpretations of such movements are being recognized as very important and practical problems especially in cases where there are difficulties in measuring these movements in the presence of unstable knee joints. In the past, numerous researches were carried out in an attempt to quantitatively measure the 3-dimensional movements of the knee joints during a normal walk. Presently, high speed photographic method, methods of using video cameras and accelerators, electro-optical techniques, and methods using exoskeletal link device are known although these methods have their strengths and weaknesses, the methods using the exoskeletal link device, which has its advantages in the attachment of the device, price and transmission of data through a computer, is used most generally.

However, devices introduced thus far are limited to measuring only the planar or 3-axial rotational movements so that they have the disadvantages of not being able to measure the 3-directional shifting movements which occur along with the 3-directional rotational movements as does in actual knee joint motion and not being to correct the errors resulting from fitting the electrogoniometer on soft tissues such as muscles.

To develop a convenient apparatus that can reduce such flaws and can easily be used in actual clinical setting, we had designed a new type of exoskeletal link device and by testing it on normal subjects, we measured the 3-dimensional momentum of the knee joints in walking with our results as a basis, we examined the usefulness of this device as a means of objective evaluation of knee instability in actual clinical situations by applying them in the evaluation of the post-operative conditions of the patients who underwent total knee arthroplasty and the conditions of those with past history of ligament injuries.

## Composition of the new device

For the coordinate system of human knee joints, the methods of using four-bar kinetic chain models is generally employed. Each linking device is connected by a cylindrical joint and through this joint rotational movements are possible when designed according to the coordinate system the degree of rotation at

each joint can be obtained independent of the other two.

However with these methods, there is an implied limitation that the coordinate system must precisely coincide with the direction that is either parallel or perpendicular to the long axis of tibia and femur.

Therefore, instead of such ordinary methods, a means of measuring the relative 3-dimensional position of the bar (tibia) that moves about the fixed bar (femur) was designed.

The apparatus used in this study is composed of 3 joints, 6 electrogoniometers which read the differences in electric potential, fixating device to attach the above parts to the lower limbs, and a computer for data analysis (Fig. 1). The joint was constructed with 2 universal joints and 1 pin joint between them to allow the knee joints to move in all directions during walking. The electrogoniometer attached to the device measured the relative angle of rotation in each joint while an additional electrogoniometer installed below the lower universal joint determined the axial rotation. Each electrogonio-

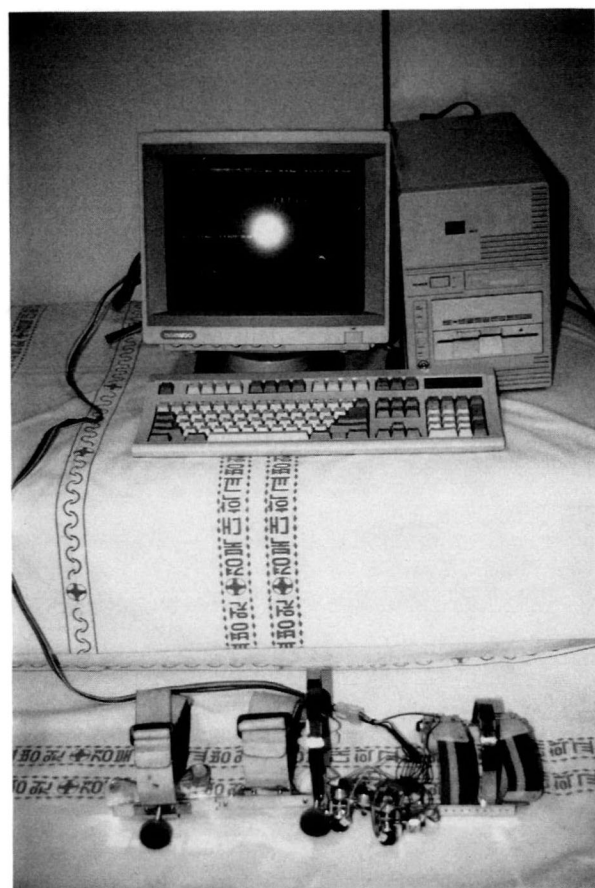


Figure 1. Composition of the equipment.

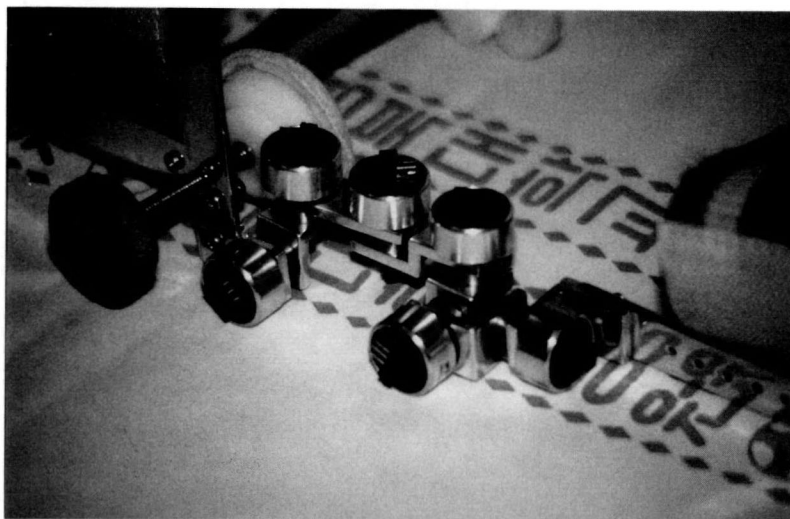
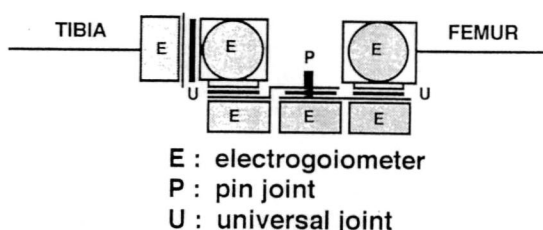


Figure 2. The structures of the electrogoniometers and joints : 2 universal joints, 1 pin joints and 6 electrogoniometers

meter was designed such a fashion that when it was fed a constant voltage of 10V it read the voltage that corresponded to its rotation and would convert these values into rotational angles (a voltage change of 1/180V is equivalent to 1° of rotation), the results of which were then divided into 3 axial directions such as flexion/extension, rotation, adduction/abduction, and expressed the results as curves with additional markings of a moving locus on a 3-D coordinate system (Fig.2).

To put these devices on the subjects legs, the upper portion was fixed to the medial and lateral condyle of the distal femur, the lower portion subcutaneously to the anterior of tibia with 2 additional bands each to the upper and lower portions as a reinforcement (Fig.3).

## Materials and Methods

In order to measure the range of knee joint movements in normal individuals during a walk by using this device, we had selected the right knees of 100 adults with no prior history of injury that could affect their walking, no complaint of symptoms of ill-

ness and no abnormal findings on a physical examination. Each was allowed to wear the newly designed exoskeletal device and to walk as they normally would. The graph produced by the walking movements in each direction determined the ROM in each direction while the pattern of movements corresponding to different stages of walking motion were analysed through the shapes of the curves. Later, based on these results the same measurements were attempted on 10 individuals who were diagnosed as having ruptured anterior cruciate ligaments (ACL) and 10 who underwent total knee arthroplasty. The results were compared with those of normal individuals.

## Results

The following results were obtained from measuring the 3-dimensional movement of knee joints.

ROM in the direction of flexion/extension :

It ranged from a minimum of 39.89° to a maximum of 80.04° with a mean value of 55.37° (Fig.4). Furthermore, curves produced by electrogoniometer showed a bigasic pattern in which there was an ex-

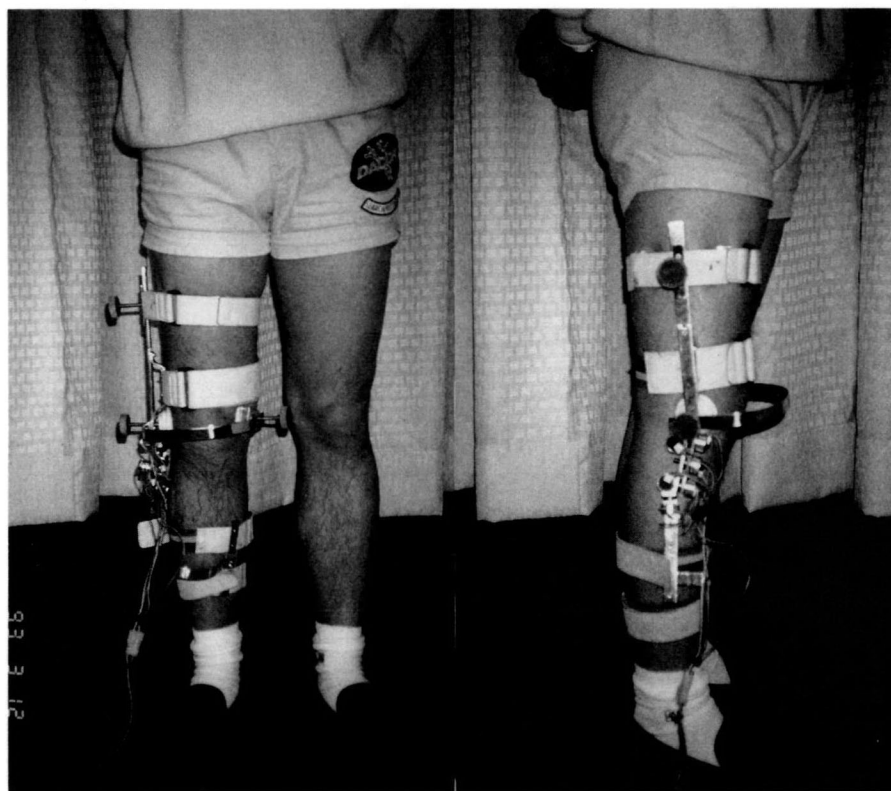


Figure 3. The figures of the equipment applied.

tension following a slight flexion and then another large flexion corresponding to the progressive stages in waling (Fig.7).

ROM in the direction of intorsion/extorsion :

The range was from a minimum of  $9.21^{\circ}$  to a maximum of  $18.09^{\circ}$  with an average of  $13.22^{\circ}$  (Fig.5). There were a maximum internal rotation immediately before the toe was off the ground (toe off) and a slight internal rotation after the heel touched the ground (heel strike) (Fig.7).

ROM in the direction of adduction/abduction :

A range from  $7.84^{\circ}$  to  $15.91^{\circ}$  with a mean of  $11.55^{\circ}$  was observed (Fig.6).

Maximum abduction was obtained when flexion was at its extreme (Fig.7).

5 of the 10 individuals with confirmed ACL injuries showed increase in the degree of movements in various directions and abnormal changes in the shapes of their movement curves (Fig. 8, 10). In 6 of the 9 subjects who had nonconstrained type total knee arthroplasty due to degenerative arthritis, same types of observations were made as mentioned above (Fig. 9, 11). In a case where an total knee arthroplasty of semi-constrained type was performed following an extensive removal of soft tis-

sues and bone tissue due to osteosarcoma, increase in ROM in all 3 directions along with abnormal movement patterns were seen (Fig. 12).

## Discussion

Measuring and understanding the 3-dimensional momentum of knee joints in normal walking is the basis in the decision making process for treatment modality of the injured knee, and design of the artificial knee joint. It also provides objective criteria in the evaluation of the patients who complaint instability while walking.

Up until now, numerous researches had attempted to measure the ROM of knee joints under passive movements (Ross, 1932 ; Brantigan and Voshell, 1953 ; Dempster, 1956 ; Depalma, 1964), and to study the dynamic movements under non-weight bearing conditions (Steindler and Arthur, 1955 ; Hallen and Lindahl, 1965).

Kettelkamp et al (1970) attempted to measure the 3-dimensional ROM of knee joints in walking using exoskeletal link device with 4 electrogoniometers attached to the adjacent areas of the knee joint.

## Flexion / Extension

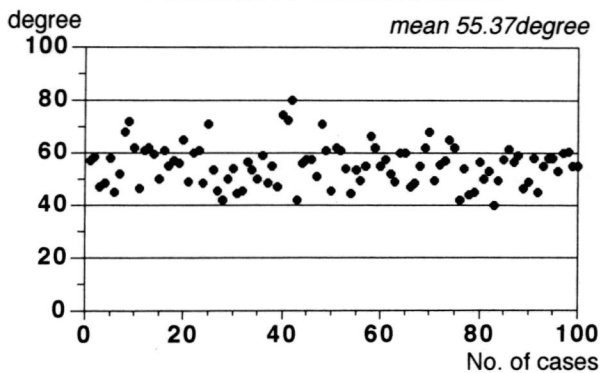


Figure 4. Distribution of the amount of knee motion on flexion/extension plane in normal people

## Rotation

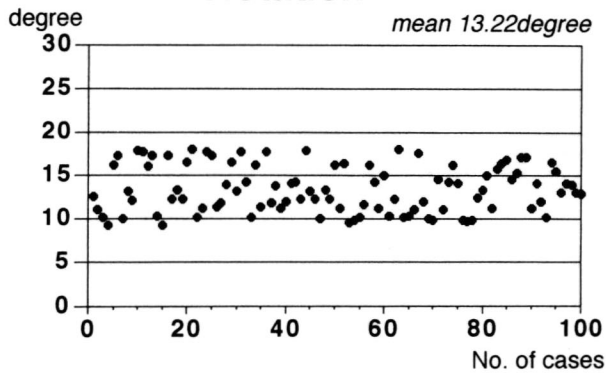


Figure 5. Distribution of the amount of knee motion on transverse plane in normal people

## Abduction / Adduction

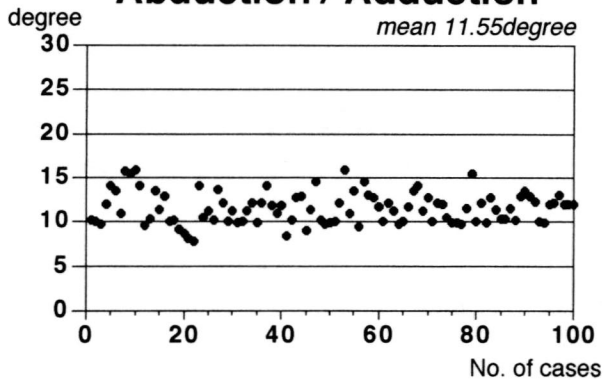


Figure 6. Distribution of the amount of knee motion an abduction/adduction plane in normal people.

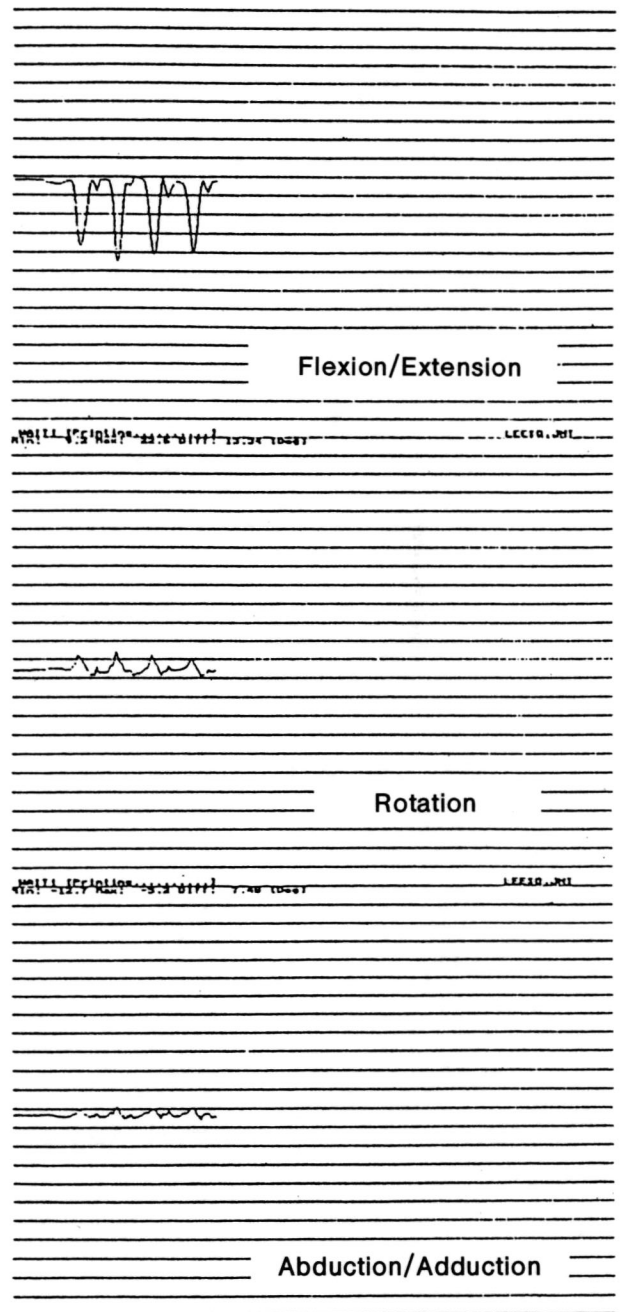


Figure 7. Electrogoniometric patterns of knee motion in a normal person.

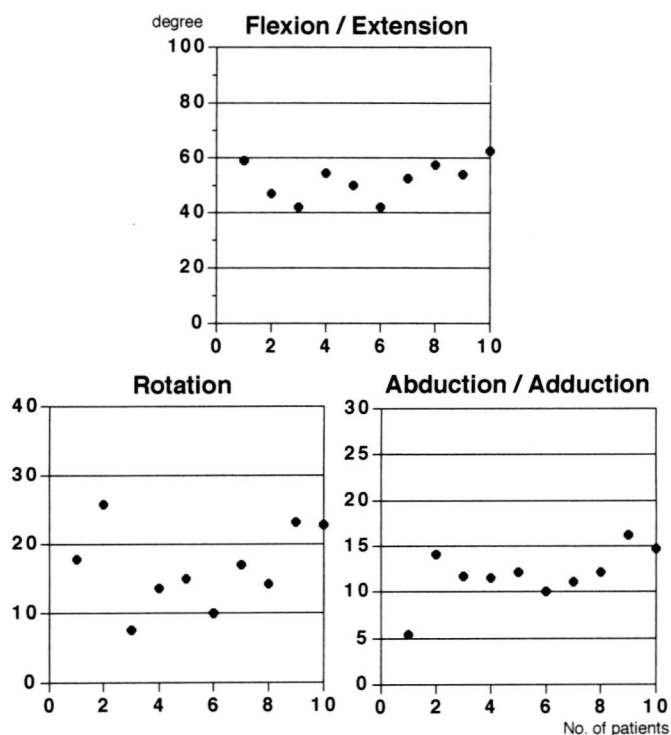


Figure 8. Distribution of the amount of knee motion in ACL injured people.

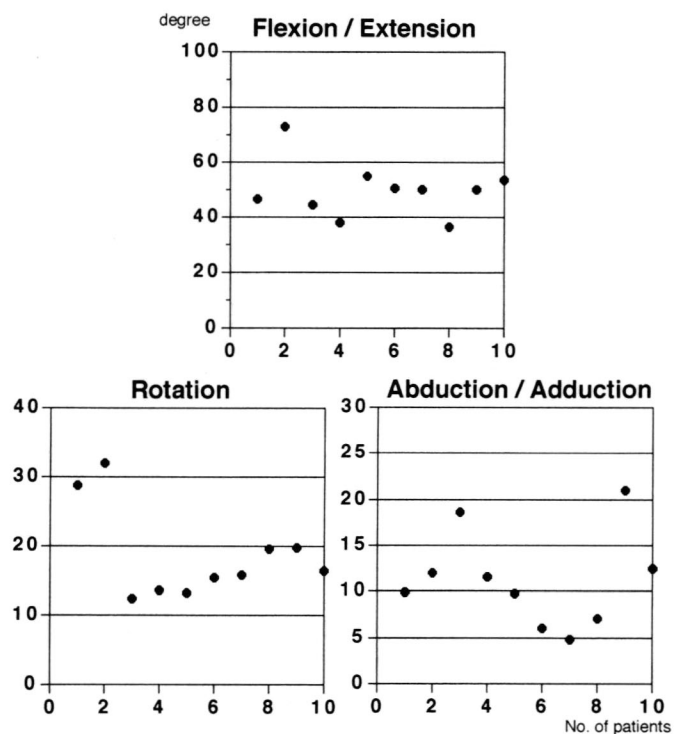


Figure 9. Distribution of the amount of knee motion in people who had total knee replacement.

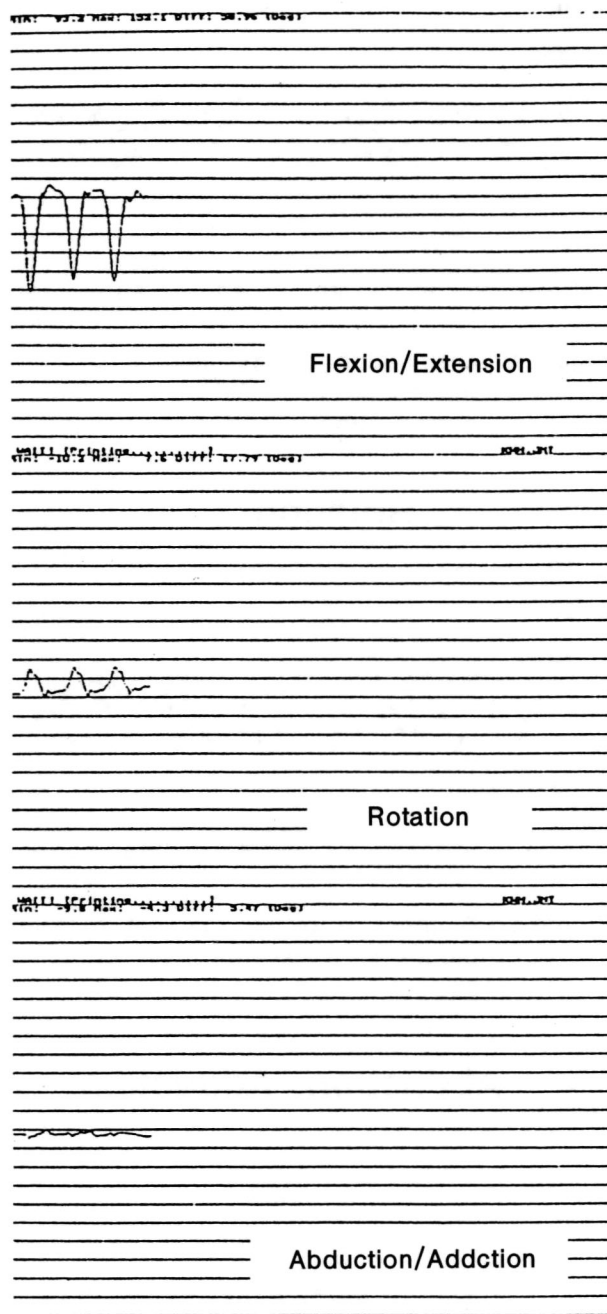


Figure 10. Electrogoniometric patterns of the knee motion of a patient with a torn ACL.  
-disappearance of biphasic pattern on flexion/extension curve



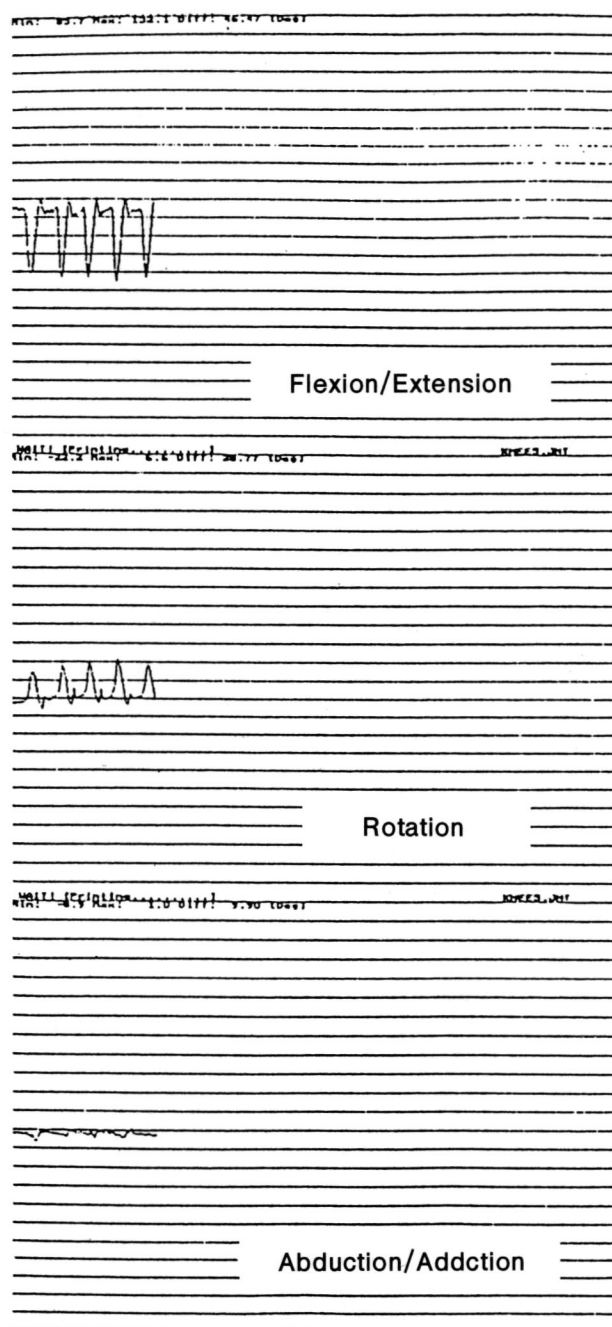


Figure 11. Electrogoniometric pattern of the knee motion of a patient who was treated by total knee arthroplasty, nonconstrained type, due to osteoarthritis.  
-increased amplitude on rotation curve

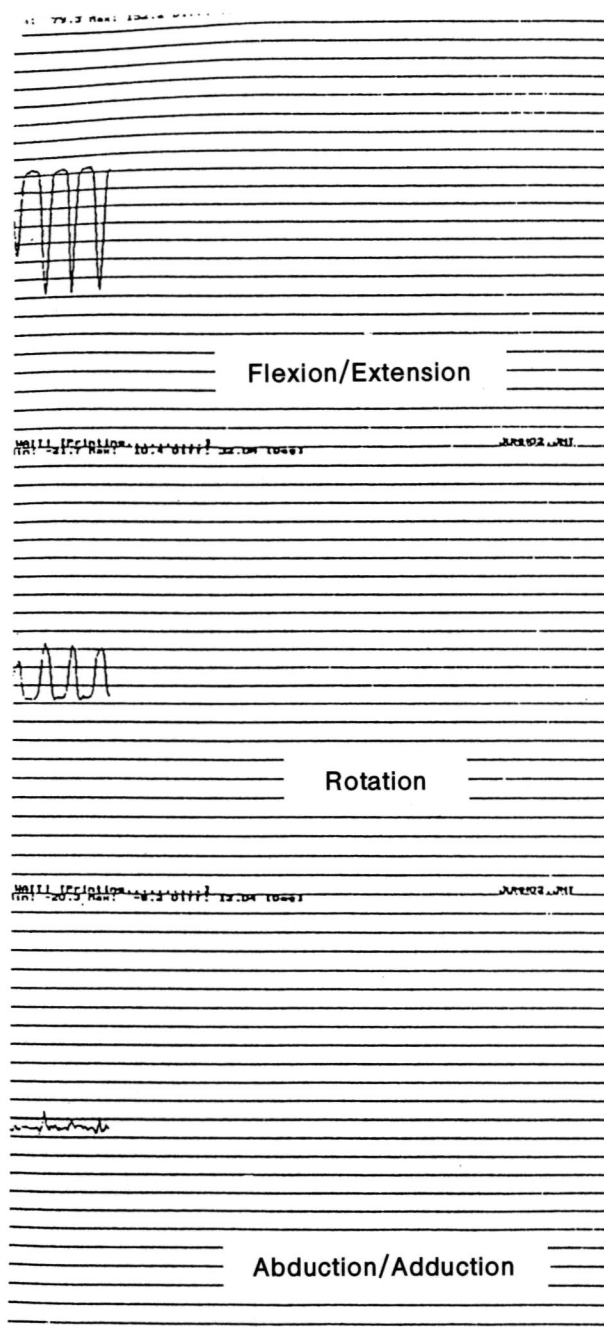


Figure 12. Electrogoniometric pattern of the knee motion of a patient who was treated by total knee arthroplasty, semiconstrained type, due to osteosarcoma of the proximal tibia.  
increased amplitude on whole direction curve  
-disappearance of normal gait pattern.



Lafortune et al (1992) tried to reduce the errors due to soft tissues by inserting a metal pin directly into femur and tibia. However, these methods are very complicated and impractical or shortcomings that there is no way to correct the errors.

In an effort to rectify these weakness, we designed a new form of exoskeletal link device that is convenient with less errors and can determined the relative 3-dimensional position of a bar (tibia) that moves about the fixed bar (femur).

Regarding the measurement of ROM in the direction of flexion/extension, Kettelkamp et al (1970) reported that there was an average of  $68.1^\circ$  of movement while Eberhart et al (1947) and Murray (1967) reported  $70^\circ$  and  $65^\circ$  of movements respectively. In this study that value appears to be relatively small at  $55.37^\circ$ , and this may be due to the fact that the subjects might have participated in the experiments with unnatural walking patterns that differed from their normal, usual patterns.

The curves representing the electrical potential differences showed biphasic pattern in which there were a smaller angular flexion during the stance phase and a maximal flexion during the swing phase similar to those in the study done by Lafortune et al (1992).

In our case, the momentum of knee in the direction of rotation, ranged from a minimum of  $9.21^\circ$  to maximum of  $18.09^\circ$  with an average of  $13.22^\circ$  while the results Kettelkamp et al (1970) obtained by using exoskeletal link device showed values between  $5.7^\circ \sim 25.3^\circ$  with a mean of  $12.0^\circ$ . On the other hand, Eberhart et al (1947) reported a range of values from  $4.1^\circ \sim 13.3^\circ$  with  $8.7^\circ$  as their average.

There were a maximum internal rotation immediately before the toe off and a small degree of internal rotation after the heel strike and these agree with the report by Lafortune et al (1992) who made the analysis with an insertion of metal pins into the cortical bone.

With respect to the movements in the adduction/abduction direction, our values were from  $7.84^\circ$  to  $15.91^\circ$  with  $11.55^\circ$  as our average. These values were greater than Eberhart et al (1947) and Kettelkamp et al (1970) who reported  $8 \sim 9^\circ$  and  $9.7^\circ$ , respectively. In accordance with the report by Lafortune, maximum abduction occurred when flexion was at its peak.

In 5 of the 10 subjects with injured ACL and 7 of the 10 who underwent artificial total knee arthroplasty, there were increase in the amount of movements and changes in the movement patterns.

We believe that measuring of the 3-dimensional

movements of the knee joints under dynamic conditions with newly developed instrument, could allow us to objectively grasp the actual instability and could be applied towards its proper treatment afterwards or choosing supplementary supportive equipments.

Our results differed from those of other researches involving varying amount of movements in each direction. These differences could be accounted for by the subjects' race, physical condition, age, sex and also the differences in the number of subjects participated and the degree of their sincerity towards these experiments. We feel that need more studies to developed more accurate and simple device.

## Summary

We developed a new form of exoskeletal link device which is convenient to use and yet can reduce errors and examined the knee movements in walking 3-dimensionally to get the following results.

1. In normal individuals, ROM in the direction of flexion/extension was from a minimum of  $39.89^\circ$  to a maximum of  $80.04^\circ$  with  $55.37^\circ$  as the average. Moreover, the curves produced by electrogoniometer showed a biphasic pattern with an extension following a slight flexion and then another significant flexion corresponding to the progressive stages of walking.

- ROM in the direction of rotation showed a minimum  $9.21^\circ$  to a maximum  $18.09^\circ$  and a mean value of  $13.22^\circ$  with a maximum internal rotation right before the toe off and smaller degree of internal rotation after the heel strike.

- Movements in the direction of adduction/abduction ranged from  $7.84^\circ$  to  $15.91^\circ$  with an average of  $11.55^\circ$ . Maximum abduction occurred when flexion was at its maximum.

- Increase in the degree of activity in each direction and abnormal changes in movement curve patterns were observed in 5 of the 10 people with confirmed ACL injury and 7 out of the 10 who had total knee arthroplasty.

- As evidenced above, we believe that the new form of exoskeletal link device used in this study is valuable not only in measuring the 3-dimensional momentum of knee joints in normal gait but also in objective evaluation of the instability of morbid knee joints under dynamic conditions.

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# Arthroscopy for the Stiff Elbow

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## ●Key words

Loose body, Osteochondritis dissecans, Intra-articular fracture

## ●Abstract

The arthroscopic surgery was performed in twenty-five patients with stiff elbow. The following procedures were performed according to the intra-articular pathology : removal of loose bodies, resection of osteophyte, anterior capsular release, abrasional arthroplasty, and excision of radial head. The mean range of the joint motion was 92°, pre-operatively. The post-operative result was 116° (average follow-up : 19 months). The satisfactory results were obtained in twenty-three patients (92%). They showed improvement in carrying out daily activities. Therefore, the arthroscopy of the elbow is an effective diagnostic and therapeutic procedure for the intra-articular problems with minimal morbidity and rapid functional recovery.

Stiffness of the elbow joint may result from a variety of causes, such as trauma, heterotopic ossification, burn scar contracture, spasticity, and postoperative scarring.<sup>3,5</sup> Intra-articular lesions causing limitation of motion are loose bodies, osteophyte on olecranon, synovitis, adhesion, osteochondritis dissecans of capitellum, and chondromalacia of the radial head.<sup>1</sup> Conservative treatment and open surgical treatment for the stiff elbow have offered unsatisfactory results. Therefore, most orthopedic surgeons were reluctant to use these procedures. But, with development of the arthroscopic surgery, the satisfactory results were reported in the recent literatures. In this study, the authors presented the result of arthroscopic treatment for the stiff elbow in 25 patients.

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## Materials and Methods

From January 1991 through December 1993, the arthroscopic treatment was performed in 25 patients (26 cases) with the stiff elbow. There were twenty males and five females with an average age of 34 years (range, 11 to 68 years). The mean duration from the onset of symptom to the arthroscopic treatment was 42 months (range, six months to 15 years). The most common cause of the stiff elbow was trauma-related lesions (48%), the second was sports-related lesions (28%) (Table 1). The mean of the maximum extension (flexion contracture) of the elbow was 21 degrees (range, 5 to 80 degrees), preoperatively. The mean of the maximum flexion was 113 degrees (range, 50 to 140 degrees).

The arthroscopy was indicated when the elbow motion was so restricted that the daily activity was disturbed or when the range of motion did not improve despite physical therapy at least six months. The arthroscopic procedures were as follows according to the intra-articular lesions: removal of loose bodies, resection of osteophyte, release of anterior capsule, abrasional arthroplasty, and excision of radial head. The mean duration of follow-up was 19

months (range, 6 to 45 months). We examined all patients in our department, and all patients responded to a written questionnaire. The clinical results were evaluated according to the scale developed by Morrey et al.<sup>10</sup> in the Mayo clinic (Table 6).

## Techniques

The elbow arthroscopy was performed under the general anesthesia or the axillary block (3 cases). The position of the patient was supine or prone. Recently, we have proposed the prone position due to less neurovascular complications. The pneumatic tourniquet was applied on the upper arm near axilla with appropriate pressure. The main portals were anterolateral, anteromedial, posterolateral, and proximal medial. Two accessory portals, direct lateral and direct posterior, were added if necessary.

The bony landmarks were outlined on the radial head, the lateral and medial epicondyle of humerus, and the olecranon of ulna with a marking pen. The anterolateral portal was placed 3 cm distal and 2 cm anterior to the lateral humeral epicondyle. The anteromedial portal was placed 2 cm anterior and 2 cm distal to the medial humeral epicondyle. The posterolateral portal was 3 cm proximal to the olecranon tip, just superior and posterior to the lateral epicondyle and lateral margin of triceps muscle. The proximal medial portal was located 2 cm proximal to the medial humeral condyle. The direct lateral portal was located between the lateral humeral epicondyle, tip of olecranon, and radial head. Through these portals, arthroscopic procedures were performed.

After removal of loose bodies and excision of the radial head, we confirmed the post-operative status with radiographic evaluation at operating room. The excision of the osteophyte was performed with osteotome and motorized burr. For the anterior capsular release, the retrograde knife was used

Table 1. Causes of the Stiff Elbow

Cause	No.
Trauma related lesion	12 ( 48 % )
Sports related lesion	7 ( 28 % )
Job related lesion	1 ( 4 % )
Non-specific lesion	5 ( 20 % )
Total	25

Table 2. Intra-articular Pathology

Pathology	No.	Incidence
Loose bodies	15 / 26	57.7 %
Osteophyte	14 / 26	53.8 %
Osteochondritis dissecans	6 / 26	23.1 %
Anterior capsular contracture	5 / 26	19.2 %
Intra-articular fractures	5 / 26	19.2 %

through the anterolateral portal and the proximal portion of the capsule was divided. The abrasional arthroplasty was performed using a motorized burr and full radius resector. Post-operatively, the active range of motion exercise was started as soon as pain and swelling were subsided.

## Results

The causes of the stiff elbow, which was confirmed during the arthroscopic examination, were as follows : loose bodies in 15 cases, osteophyte in 14 cases, osteochondritis dissecans in 6 cases, anterior capsular contracture in 5 cases, and intra-articular fractures in 5 cases. The intra-articular fractures included the radial head fractures in 3 cases and

humeral condyle fractures in 2 cases (Table 2). Bone excision procedures were performed most commonly on the olecranon in 14 cases, the second on the coronoid process in 5 cases (Table 3).

In 15 cases with loose bodies, the arthroscopic removal relieved the intermittent catching sensation and improved the mean range of motion 20 degrees. In 14 cases treated with resection of osteophyte from olecranon and coronoid process, the mean extension increased 18 degrees and the mean flexion increased 7 degrees. The anterior capsular release performed in 5 cases increased the mean extension 16 degrees. The abrasional arthroplasty performed in 6 cases increased the mean range of motion 20 degrees. In one case, the partial resection of the radial head and the abrasional arthroplasty were performed. In this patient, flexion increased 45 degrees and supination increased 75 degrees. (Table 4).

Pre-operatively, the mean angle of maximum extension was 21 degrees and maximum flexion 113 degrees. At the last follow-up examination, the mean angle of maximum extension was 14 degrees and maximum flexion 130 degrees. The mean range of motion increased 24 degrees (Table 5).

The clinical results improved 1.8 points according to the scale of Morrey et al.<sup>10</sup> The mean score was 2.8 points pre-operatively and 4.6 points post-operatively. Twenty-three patients (92%) were satisfied with the result of the procedure. In two cases, the range of motion did not improve, but the pain diminished.

Table 3. Site of Bone Lesion

Site of Bone Lesion	No.
Olecranon	14
Coronoid process	5
Radial head	4
Capitellum	2
Trochlea	2
Distal humerus	2

Table 4. Improvement of ROM According to the Operative Procedures

Operative procedure	No.	Improvement of ROM
Removal of loose bodies	15	20 degrees
Excision of osteophyte	14	25 degrees
Release of anterior capsule	5	16 degrees
Abrasional arthroplasty	6	20 degrees
Excision of radial head	1	45 degrees

Table 5. Improvement of the Stiffness

	Pre-op	Post-op	Improvement
Mean angle of maximum extension	21°	14°	7°
Mean angle of maximum flexion	113°	130°	17°
Mean range of motion	92°	116°	24°

Table 6. Scale with which the Patients Rated Pain Preoperatively and Postoperatively (Morrey BF)

Description of Pain	Points
None	5
Slight, with continuous activity; no medication	4
Moderate, with occasional activity; some medication	3
Moderately severe (much pain); frequent medication	2
Severe (constant pain); marked limitation of activity	1
Complete disability	0

## Discussion

There has been many reports for the treatment of the stiff elbow. Urbaniak et al.<sup>16</sup> reported the anterior capsular release. Morrey<sup>11</sup> reported the distraction arthroplasty. And Husband<sup>6</sup> reported the lateral approach for the contracture of the elbow. These procedures, although effectively decrease the amount of contracture, are technically demanding, require extensive dissection, and consequently have the potential for significant complications.<sup>16</sup> On the other hand, the elbow arthroscopy provides a reasonable alternative with the potential benefits of decreased postoperative morbidity and rapid functional recovery.<sup>14</sup>

Elbow arthroscopy is indicated in the following situations : (1) evaluation and removal of loose bodies, (2) evaluation and treatment of osteochondritis dissecans of the capitellum, (3) evaluation and debridement of chondral or osteochondral lesions of the radial head, (4) debridement and release of adhesions of post-traumatic or certain degenerative processes about the elbow, (5) partial synovectomy in rheumatoid disease, and (6) partial excision of humeral or olecranon osteophytes.<sup>1,2,9</sup>

The effectiveness of elbow arthroscopy was assessed in 35 consecutive patients by Ward and Anderson in 1993.<sup>17</sup> All patients had preoperative pain. Loose bodies and impinging spurs were the most common preoperative and postoperative diagnoses. Flexion and extension improved an average of 9 and 6 degrees, respectively. Ogilvie-Harris and Schemitsch<sup>12</sup> reported the results of arthroscopic removal of loose bodies in 33 patients. The amount of pain decreased in 85% of the patients, locking in 92%, and swelling in 71%. Overall, 89% of patients had significant improvement through arthroscopic procedure.

In this study, the following procedures were performed : removal of loose bodies (15 cases), resection of osteophyte (14 cases), abrasional arthroplasty (6 cases), anterior capsular release (5 cases), and radial head resection (1 case). Because the several combined procedures were performed in some case, we could not evaluate the improvement of range of motion in the specific procedure respectively. But in this study, we obtained good results as in other previous reports, satisfactory clinical results in 92% and improvement of the range of motion 24 degrees.

The complications of the elbow arthroscopy are similar to those of the other joints, such as infection, problems associated with a tourniquet, breakage of the instruments, iatrogenic scuffing of the articular surfaces, and neurovascular complications.<sup>1,7,8</sup> Among these, the nerve injury was the most common complication in the previous reports.<sup>1,4,14,15</sup> In this study, there were transient median nerve palsy in two cases and breakage of the instrument (breakage of burr during the abrasional arthroplasty) in one case.

In conclusion, the elbow arthroscopy is an effective diagnostic and therapeutic procedure for the intra-articular problems with minimal morbidity and rapid functional recovery.

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# Scaphoid Stress Fracture of a High Diver

## A Case Report

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### ●Key words

Carpal scaphoid, Stress fracture

### ●Abstract

Carpal scaphoid fracture is found among wrist fracture with the highest frequency. Clinically, the symptoms of carpal scaphoid fracture shows similar symptoms of wrist sprain. Furthermore, it is very difficult to detect carpal scaphoid fracture radiologically, and it is very often that carpal scaphoid fracture cannot be diagnosed in early stage. In addition, avascular necrosis or nonunion occurs frequently in carpal scaphoid fracture due to the anatomical uniqueness and unusual vascular movement.

The origin of carpal scaphoid fracture mechanism is still unknown and under debate. There is no specific medical report which certain illustrates that is limited to certain occupations and special circumstances. However, we have treated and experienced the case of carpal scaphoid stress fracture of a 17-year-old male high diving player who suffered from the extreme pain. Thus, we would like to report this case with references.

## Introductions

Scaphoid fracture has the highest incidence in carpal bone fractures. It is clinically similar to carpal sprain in symptomatology and there are some difficulties in diagnosis by radiological findings, therefore, early diagnosis in this injury is not easy. Because scaphoid has the peculiarities in anatomical and vascular supply, scaphoid fracture has the high incidence of nonunion and avascular necrosis.<sup>2), 5)</sup> Scaphoid fractures have been on controversies in mechanisms of fractures. No one has documented the occupational relationship, what amounts of external forces are needed to develop a scaphoid fracture, nor a case report of stress fracture in scaphoid. Authors have observed a scaphoid stress fracture in 17-year-old male high diving player, who had suffered from consistent carpal pain. We report a case on the basis of our treatment experience and a review of articles.

## Case Report

A seventeen-year-old man who had a history of left carpal pain for a year that had developed from a high diving game on Asian Games, in September

1990. The pain had developed after a diving into the water with the first web space of both hands overlapped and the left hand placed superiorly, the right hand inferiorly (Fig. 1). The left carpal pain had been treated conservatively for a year with taping and elastic bandages, and he had continued the diving training and other physical trainings using the injured hand. He had a career in high diving player for five years. On admission, he stated the initial carpal pain had been disappeared, but he complained the carpal pain on extension of left wrist joint.

Physical examinations revealed a tenderness on left carpal joint, especially on anatomical snuff box, and he suffered from a pain on extension of the carpal joint over seventy-degrees with radial deviation of the joint. The range of motion of the joint on flexion and radial deviation was within normal range. Plain radiographs of anterior, lateral, and billiard view revealed a transverse fracture line in middle one-third of scaphoid with increased densities on the relatively smooth fracture line. The central portion of the lesion had a cystic change and the bone marrow cavity was discontinued (Fig. 2).

He was treated with the Matti-Russe operation. Iliac bone was grafted to the fracture site of scaphoid through palmar approach. A thumb spica cast was applied from neck of middle phalanx of the thumb to proximal forearm, with his wrist posi-



Figure. 1 Wrist position : After 1st web space of both hands are laid to overlap each other in such way that the right hand and left hand are positioned at the below and upper part respectively, the both wrist is obtained in extension condition.

tioned in neutral and radially-deviated. Postoperatively, the joint was kept immobilized for 8 weeks. Roentgenograms made at the time of follow-up demonstrated the evidence of bony union (Fig.3).

We have a plan for gradual rehabilitation from basic physical training using the carpal joint to returning to the diving training, in the case of complete bony union after postoperative 3 or 4 months of follow-up.

## Discussion

There are various mechanisms of scaphoid fracture. Weber<sup>9)</sup> reported that scaphoid fractures could be occurred by extension and radial deviation force of wrist joint. On the contrary, Mayfield<sup>6)</sup> reported scaphoid fractures were resulted from applying a ulnar deviation force to the wrist joint with hyperextension of the joint. Chung et al<sup>1)</sup> reported that rotation of scaphoid to the direction of narrowing down



Figure. 2 Preoperative radiologic finding : on one third of the middle section in left scaphoid, its fracture line is visible with the growth of radiodense. Also, cystic change and smooth fracture site is observed on the middle section.



Figure. 3 Postoperative radiologic finding : 8 weeks after the operation. Union evidence is visible on the fracture site.

the scaphoid-lunate interval result in anterior tensile force and posterior compression force, and these forces induce the fracture of scaphoid as a consequence. In our case, hyperextension and radial deviation force applied to the superiorly placed left wrist joint and the force generated from water entering, were combined and applied repeatedly to the scaphoid bone and resulted in a stress fracture.

Russe<sup>7)</sup> classified the scaphoid fracture by its anatomical location into proximal, middle, and distal fractures. Sotto-Hall<sup>8)</sup> divided the scaphoid fractures into acute, subacute and chronic (more than 6 months) fractures, according to the duration from an onset. Roentgenological classification divides scaphoid fractures into stable acute fractures, type A; unstable acute fractures, type B; delayed union, type C; and non-union, type D. Our case corresponds to the middle fracture in Russe classification, and chronic fracture in Sotto-Hall classification, and type D, roentgenologically.

Treatment of scaphoid non-union includes spondylectomy, proximal fragment excision, proximal-low carpectomy, and grafting operations. Hooning Van Duyvenbode et al.<sup>4)</sup> reported a good result in 77 cases of scaphoid non-union patient treated with Matti-Russe grafting operation with volar approach. Ha et al.<sup>3)</sup> reported that they obtained a good result from 27 cases of scaphoid non-union treated with Matti-Russe operation except 2 cases. These 2 cases complaining carpal pain and osteoarthritis were internally fixated with Herbert screw and finally resulted in a good condition.

## Conclusion

We report an experience of a case of scaphoid stress fracture reviewed of articles, which was resulted from repeated stress of water resistance applied to the wrist in water entering position. The fracture was misdiagnosed as a carpal sprain and treated conservatively and he continued diving training for a year. We anticipate that this report dedicates to the studies on the mechanism of scaphoid fractures.

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# Lumbar Burst Fracture in Paragliders

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## ●Key words

Spine injury, Paragliders, Sports injury

## ●Abstract

In paragliding, loss of lifting force by the collapse of sail or turbulence of air leads to a rapid fall and landing on the buttock. In those instances, lumbar spine is maintained upright by the remained partial pulling force of the relatively light weight of the equipment. As a result of the fall, lumbar spine sustain an injury from the axial loading force.

The authors experienced six cases of lumbar spine fracture requiring surgical treatment among 400 active paragliders in Kwangju area during the last three years.

Mechanism of fracture was burst type B by Denis classification in all cases. Level of the lesion was L2 in three, L3 in two and L4 in one. Neulological involvement was not observed. Method of operations was anterior decompression by proximal corpectomy in three and by total corpectomy in one and short segment transpedicular instrumentation in two.

All showed solid bony union within three months. Extent of fusion was one motion segment in cases with proximal hemicorpectomy while it was two motion segment in the cases treated by the other methods.

In conclusion, the authors believe that burst type fracture of lumbar spine is prevalent in paragliders and the treatment by proximal hemicorpectomy minimizes the fusion segment in such cases.

## Introduction

Paragliding is a new sport that is flying downhill with a special type of parachute. It originated from parachuting in around 1960 and improved to a sport in 1984. Since it has been introduced to Korea in 1987, it is getting popular<sup>1,5,6)</sup>. The paragliding was introduced to Kwangju area which about 1 million inhabitants in 1989, and the active members of pilots increased up to 400 in the end of 1993.

During the last three years in Kwangju area, there was about 20 spine injuries in paragliding accident, and six of them needed operative treatment.

This is to report our experience on the features of the spine injury in paragliders, and on the methods of operative treatment that minimize the extent of fusion area to prevent the restriction of lumbar motion and to shorten the healing period.

## Clinical Materials

For three years from December, 1990 to December, 1993, six patients sustained lumbar spine frac-

tures during paragliding and they were treated operatively. Follow up period was 6 to 30 months. They were active young patients with an age-range of 21 to 31 years (Av. 26.7 years). They were five men and an woman. Causes of accident were personal factors including carelessness or misjudgement by the pilot in five and gust of wind in one.

Gliding career at the time of accident was less than 30 times in two, between 30 to 100 in one, and over 100 in three. Level of the lesion was second lumbar vertebra in two, third in three and fourth in one.

Type of the fracture mechanism was burst type B by Denis classification<sup>4)</sup> in all cases, Spinal canal involvement by retropulsed bony fragment was 40-80% (Av. 57%). Neurological deficits were not observed.

As the operative procedures, three methods were performed. Anterior resection of crushed proximal half of the body and mono-segmental interbody fusion using iliac bone blocks and MOSS (Modular Segmental Spinal) instrumentation were used in three cases (Fig. 1). Anterior decompression by total corpectomy and fusion using Kaneda device<sup>8)</sup> was done in one. Short segment transpedicular

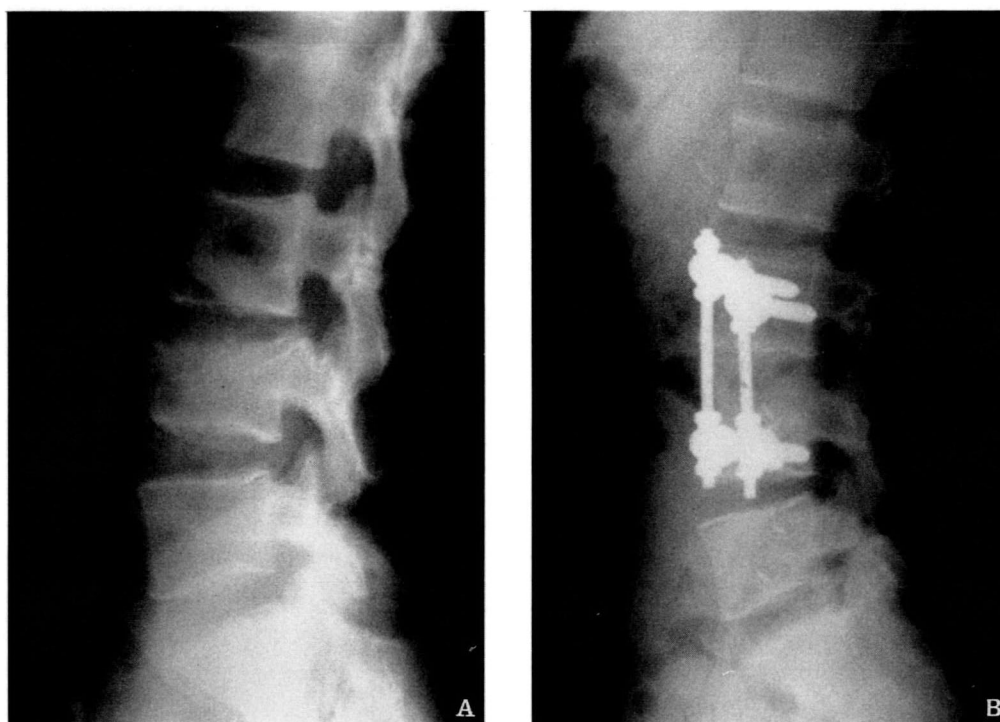


Fig. 1-A, B. Denis type B burst fracture of L 3 was treated anteriorly by proximal hemicorpectomy and monosegmental fusion. Two movable motion segments are remained below the level.

Table 1. Clinical Materials

	Sex	Age	Level of Injury	Types of mechanism	Canal involvement	Method of operation	Fused segments
1	M	26	L3	Burst B	80%	Hemicorpectomy	1 seg.
2	M	27	L4	Burst B	60%	Hemicorpectomy	1 seg.
3	F	61	L2	Burst B	60%	Hemicorpectomy	1 seg.
4	M	21	L2	Burst B	40%	Total corpectomy	2 seg.
5	M	31	L3	Burst B	50%	Transpedicular	2 seg.
6	M	29	L3	Burst B	50%	Transpedicular	2 seg.

Cotrel-Dubousset instrumentation screwing into the upper and lower adjacent vertebra as well as the fractured one<sup>3)</sup> were performed in two (Fig. 2). Postoperatively, ambulation was possible within 7 days after operation in all. External support by plastic orthosis of under arm type was applied for two to three months in accordance with the stability (Table 1).

## Results

Solid bony union was observed within 3 months in all cases. Extent of fusion area was one motion segment in three cases of anterior proximal hemicorpectomy, while it was two motion segment in the other three cases treated by other methods. Operative complications such as infection, metal failure, collapse of grafted bone, recurrence of deformity and

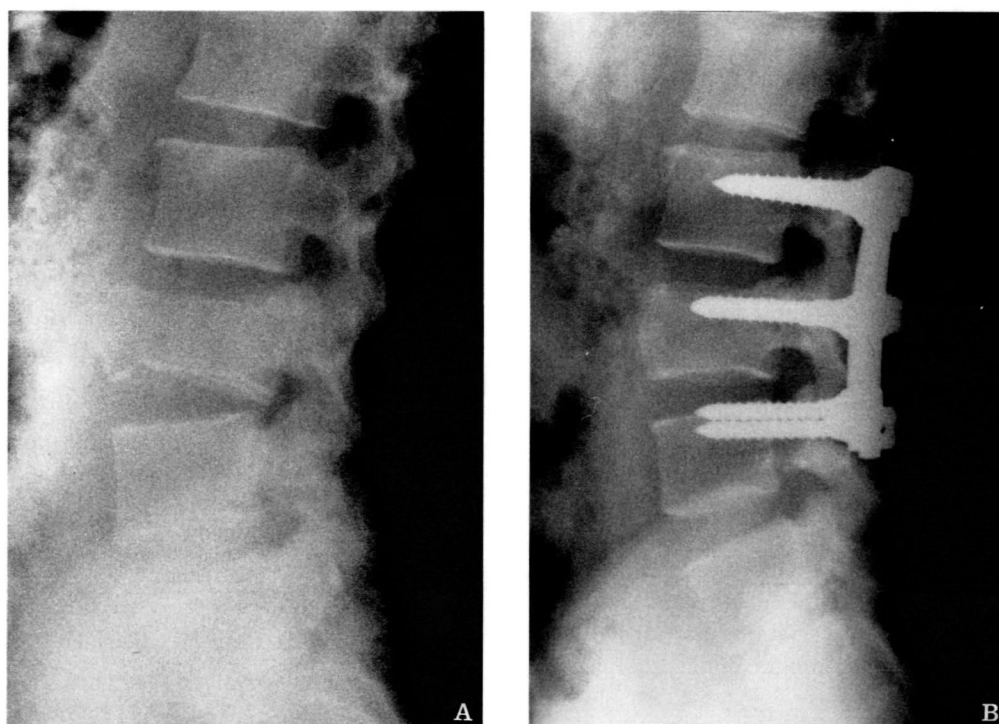


Fig. 2-A, B. Denis type B burst fracture of L 3 was operated by transpedicular C-D instrumentation. Only one motion segment was left below the fused area.



Table 2. Occupational activity

Normal	5
Reduced	1*
Unable	0
Admission	0

\* Total corpectomy case

Table 3. Sports activity

Paragliding	2
Other sports	3
None	1*

\* Total corpectomy case

neurological deterioration were not observed.

Five patients had the same occupational activities as preoperative activities and one patient with total corpectomy and fusion with Kaneda device showed significantly reduced activity and changed the job from out door laborer to a stationary one (Table 2).

Five patients regained sports activities, among them two could enjoy paragliding again, while the other three changed to easier sports (Table 3).

## Discussion

Paragliding has become more popular and the related injuries has been reported increasing<sup>13,14)</sup>. The analysis of the localization of the trauma documented the incidence of thoracolumbar spine injuries from 24% to 45.9% and the most prevalent location was lumbar spine<sup>9,10,11,12)</sup>.

Spine injuries may occur during the phase of take off or flight. During the phase of take off, the pilot would be landed on his buttock when he overestimated lifting airstream or when he sat back too early. During flight, collapse of the sail or turbulence of air eliminates the lifting force which leads to a rapid fall<sup>15)</sup>. In both conditions, the posture of pilot is maintained up-right by the remaining partial pulling force of the relatively light weight of the equipment just a shuttlecock.

Therefore, the lumbar spine sustains axial loading force and the burst type fracture may occur. In the authors' cases, all were type B burst fracture by Denis classification. On the other hand, Zellner et al<sup>15)</sup>

reported the prevalence of compression type fractures (41.5%). Further investigation would be necessary to identify the difference.

In this series, as in other reports, neurological deficit was not observed, despite the spinal canal involvement of 40 to 80% by the retropulsed fragment. The low incidence of neurological deficit may be due to the relatively low energy impacting force by the remained lifting force and the relatively wide safety margin of the lumbar spine for the canal compromise than the thoracic spine<sup>2,7)</sup>.

For the treatment, operative decompression with rigid stabilization is indicated when the spinal canal compromise is more than 40% or unstable. As the spine injuries are prevalent in the lumbar spine, saving the spinal motion segment is an important point of consideration, especially in its lower part, to preserve the valuable lumbar motion and to prevent early degenerative change of remaining motion segments. The importance is emphasized when their young ages are considered.

In authors' series, cases with anterior decompression by proximal hemicorpectomy and fusion of one motion segment showed better clinical results than the cases treated by the other methods.

Although, our experience is very limited in number, the authors believe that Denis type B burst fracture of the lumbar spine is prevalent in paragliding. Treatment by the proximal hemicorpectomy and monosegmental fusion is recommended when the operative management is indicated.

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**日本整形外科スポーツ医学会**



# 日本整形外科スポーツ医学会会則

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## 第1章 総 則

- 第1条 名称  
本会の名称は、日本整形外科スポーツ医学会（The Japanese Orthopaedic Society for Sports Medicine）略称、JOSSMという  
以下、本会という
- 第2条 事務局  
本会の事務局を、横浜市中区新山下3-2-3  
横浜市立港湾病院内に置く

## 第2章 目的および事業

- 第3条 目的  
本会は、整形外科領域におけるスポーツ医学並びにスポーツ外傷と障害の研究の進歩・発展を目的とし、スポーツ医学の向上とスポーツの発展に寄与する
- 第4条 事業  
本会は、第3条の目的達成のために次の事業を行なう
- 1) 学術集会の開催
  - 2) 機関誌「日本整形外科スポーツ医学会雑誌」（Japanese Journal of Orthopaedic Sports Medicine）の編集・発行
  - 3) 内外の関係学術団体との連絡および提携
  - 4) その他、前条の目的を達成するために必要な事業

## 第3章 会 員

- 第5条 会員の種類  
本会の会員は、次のとおりとする。
- 1) 正 会 員 本会の目的に賛同し、所定の登録手続きを行なった医師
  - 2) 準 会 員 本会の目的に賛同し、所定の登録手続きを行なった正会員以外のもの
  - 3) 特別会員 現在および将来にわたり本会の発展に寄与する外国人医師
  - 4) 名誉会員 本会の発展のために、顕著な貢献をした正会員および外国の医師のうちから、理事長が理事会及び評議員会の議を経て推薦するもの
  - 5) 賛助会員 本会の目的に賛同し、所定の手続きを行なった個人または団体
  - 6) 臨時会員 上記1～4の会員ではなく、本会の学術集会に出席し、会場費を支払った個人または団体
- 会員期間は、その学術集会の期間とする
- 第6条 入会  
本会の正会員、準会員または賛助会員として入会を希望するものは、所定の用紙に記入の上、会費をそえて、本会事務局に申し込むものとする  
入会資格は別に定める  
但し、特別会員および名誉会員に推薦された者は、入会の手続きを要せず、本人の承諾をもって、会員となりかつ会費を納めることを要しない

第7条 退会

- 1) 会員が退会しようとするときは、本会事務局に届けなければならない
- 2) 会費を2年以上滞納した場合には、退会したものとみなす

第8条 除名

本会の名誉を傷つけ、また本会の目的に反する行為のあった場合、理事会は会員を除名することができる

## 第4章 役員，評議員

第9条 役員

本会には、次の役員を置く

- 1) 理事 若干名を置く（うち理事長1名、常任理事若干名）
- 2) 監事 2名

第10条 役員の選出

- 1) 理事長および常任理事は、理事会において理事の中から選出する
- 2) 理事および監事は、評議員の中から選出し、総会の承認を要する

第11条 役員の業務

- 1) 理事長は、会務を統括し本会を代表する
- 2) 理事は、理事会を組織し重要事項を審議、決定する
- 3) 常任理事は、理事長を補佐し常務を処理する
- 4) 監事は、本会の会計および会務を監査する

第12条 役員の任期

役員の任期は3年とし、再任は妨げない

第13条 評議員

- 1) 本会には50名以上100名以内の評議員を置く
- 2) 評議員は正会員の中から選出する
- 3) 評議員は評議員会を組織して、本会役員の選出を行なうほか、理事会に助言する
- 4) 評議員の任期は3年とし、再任は妨げない

## 第5章 委員会

第14条 委員会

理事会は必要に応じて、委員会を設けることができる

## 第6章 会 議

第15条 理事会

- 1) 理事会は理事長がこれを召集し、主宰する
- 2) 会長は理事会に出席できる

第16条 総会および評議員会

- 1) 総会は正会員および準会員をもって組織する
- 2) 総会および評議員会は、それぞれ年1回学術集会開催中に開催する
- 3) 総会および評議員会の議長は、理事長または、理事長の指名した者とする
- 4) 臨時総会および臨時評議員会は必要に応じて、理事長がこれを召集できる

## 第7章 学術集会

### 第17条 学術集会

- 1) 学術集会は年1回開催し、会長がこれを主宰する
- 2) 会長、次期会長は理事会の推薦により、評議員会および総会の承認を経て決定する
- 3) 学術集会での発表の主演者および共同演者は、原則として本会の正会員に限る

## 第8章 会費および会計

### 第18条 正会員、準会員および賛助会員の年会費は別に定める

### 第19条 本会の経費は会費、および寄付金その他をもってこれに当てる

### 第20条 本会の目的に賛同する個人および団体から寄付金を受けることができる

### 第21条 本会の収支予算および決算は理事会の決議を経て評議員会、総会の承認を得なければならない

### 第22条 既納の会費は、これを返還しない

### 第23条 本会の会計年度は、4月1日に始まり、翌年の3月31日に終わる

## 第9章 附 則

### 第24条 本会則の改正は、評議員会において、出席者の過半数以上の同意を必要とし、総会の承認を要する

- 附 記
- 本会則は、昭和57年6月5日から施行する
  - 本改正会則は、昭和63年4月1日から施行する
  - 本改正会則は、平成4年6月1日から施行する
  - 本改正会則は、平成6年6月17日から施行する



## 名誉会員・特別会員

青木 虎吉  
今井 望  
河野 左宙  
榊田喜三郎  
鈴木 良平

高岸 直人  
津山 直一  
鞆田 幸徳  
鳥山 貞宣  
廣畑 和志

Bernard R. Cahill  
Wolf-Dieter Montag  
W. Pforringer  
George A Snook

## 理事

井形 高明  
生田 義和

石井 清一  
高澤 晴夫

田島 直也  
中嶋 寛之

原田 征行  
守屋 秀繁

## 監事

東 博彦

市川 宣恭

## 評議員

赤松 功也  
秋本 毅  
阿曾沼 要  
阿部 正隆  
有馬 亨  
井上 一  
今給黎篤弘  
上崎 典雄  
大久保 衛  
大畠 襄  
岡崎 壯之  
加藤 哲也  
菊地 臣一  
城所 靖郎  
栗山 節郎

黒木 良克  
黒坂 昌弘  
黒澤 尚  
古賀 良生  
腰野 富久  
小山 由喜  
左海 伸夫  
阪本 桂造  
酒匂 崇  
佐々木鉄人  
佐藤 光三  
史野 根生  
柴田 大法  
霜 礼次郎  
白井 康正

新名 正由  
須川 勲  
菅原 誠  
高尾 良英  
高倉 義典  
竹下 満  
竹田 毅  
田島 寶  
立花 陽明  
田渕 健一  
土屋 正光  
戸松 泰介  
富永 積生  
丹羽 滋郎  
乗松 敏晴

乗松 尋道  
初山 泰弘  
林 浩一郎  
平澤 泰介  
廣橋 賢次  
福田 眞輔  
福林 徹  
藤巻 悦夫  
星川 吉光  
増島 篤  
松井 宣夫  
松崎 昭夫  
圓尾 宗司  
萬納寺毅智  
宮津 誠

宮永 豊  
武藤 芳照  
茂手木三男  
安田 和則  
矢部 裕  
山本 博司  
山本 龍二  
横江 清司  
吉松 俊一  
龍 順之助  
若野 紘一  
渡辺 好博  
渡会 公治

(敬省略)

## 賛助会員

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(94年度)

旭化成工業株式会社

アルケア株式会社

石井医科工業株式会社

科研製薬株式会社

三共株式会社

三進興産株式会社

塩野義製薬株式会社

清水製薬株式会社

株式会社松本医科器械

株式会社 武内義肢製作所

日本シグマックス株式会社

ブリストル・マイヤーズスクイブ株式会社

中外製薬株式会社

日本ルセル株式会社

日本レダリー株式会社

藤沢薬品工業株式会社

株式会社ヘリオ

メディカル・システム・サービス株式会社

東芝メディカル株式会社

# 学術集会について

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## 第21回 日本整形外科スポーツ医学会学術集会

会 長 守屋秀繁（千葉大学整形外科教授）  
開催日 平成7年6月29日（木）スポーツアクティビティデー  
（ゴルフ・テニス・ジョギングなど）  
平成7年6月30日（金）・7月1日（土）学術集会  
開催地 幕張メッセ国際会議場  
連絡先 千葉大学医学部整形外科内  
〒260  
千葉県千葉市中央区亥鼻1-8-1  
Tel (043) 222-7171 内線 5303  
Fax (043) 226-2369

## 第22回 日本整形外科スポーツ医学会学術集会

会 長 林浩一郎（筑波大学整形外科教授）

# お知らせ

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日本整形外科スポーツ医学会  
会 員 各 位 殿

拝啓 時下益々ご清祥のこととお喜び申し上げます。

去る10月8日に行なわれました、日本整形外科スポーツ医学会理事会において、本学会理事長、常任理事が決定いたしましたので、ご報告いたします。

日本整形外科スポーツ医学会は1975年の創設以来、整形外科領域におけるスポーツ医学の研究を進めてまいりました。

毎年の学術集会の開催、学会雑誌の発行をはじめ、近年は海外との学術の交流も盛んで、国際的にもスポーツ医学の発展に寄与する団体として活動しています。

本年より学会の組織も理事会制となり、拡大する学会の事業内容を充実させていくことになりました。

就任にあたり、会員各位の一層のご理解とご協力をたまわりたく、ごあいさつ申し上げます。

敬 具

1994年10月

日本整形外科スポーツ医学会

理事長 高 澤 晴 夫  
(横浜市立港湾病院 院長)

常任理事 井 形 高 明  
(徳島大学整形外科 教授)

## '95年度 日本整形外科スポーツ医学会(JOSSM)・ドイツ整形外科スポーツ医学会(GOTS)・韓国整形外科スポーツ医学会(KOSSM)間のフェローについて

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'95年度のフェローは下記の4名に決定し、来年5月～6月にドイツ、オーストリア、スイスの大学・病院の施設訪問とドイツ整形災害スポーツ医学会総会での演題発表を行います。

麻生 伸一 (京都府立医科大学)

田中 康仁 (奈良県立医科大学)

Hee-Soo Kyung (Kyungpook National University)

Myung Chul Lee (Seoul National University)

## 日本整形外科スポーツ医学会 年会費について

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日本整形外科スポーツ医学会年会費について、下記のとおりご案内致します。

### 記

金 額 : 1994年度 12,000円

納入方法 : 銀行振込による納入

学会誌に綴込んである振込依頼書をご利用の上、個人名でお振込み下さい。止むを得ず病院名、大学名で振込まれる場合は、必ず参考欄に個人名を記入して下さい。

納入締切 : 1994年12月30日(金)

※ 自動振替による納入方法もございますが、1994年度会費の振替については既に締切りました。1995年度会費より、自動振替による納入をご希望の方は、事務局まで用紙をご請求下さい。

※ 学会雑誌には、既に年会費を振込まれた方、自動振替の手続きをされた方にも振込依頼書は綴込んでありますので、二重支払いにならないようご注意願います。(支払い済みか、否かご不明の方は、事務局迄お問い合わせ願います。)

※ 本年12月末日迄に1994年度の年会費を納めた会員に、来年発行の学会雑誌を送付致します。未納の方は、期日迄に必ずお振込下さい。

# 学会開催のお知らせ



## 国際関節鏡・膝学会合同会議

*For registration information, either mail or fax this form to :*

IAA/ISK Combined Congress • 6300 N. River Road, Suite 727 • Rosemont, IL 60018-4226 USA

Phone : (708) 698-1632 • Fax : (708) 823-0536

演題×切日：1994年7月1日（金）

会 期：1995年5月27日（金）～6月1日（水）

場 所：香港

Hong Kong Convention and Exhibition Center

日本での問い合わせ先：〒591

堺市長曽根町1179-3

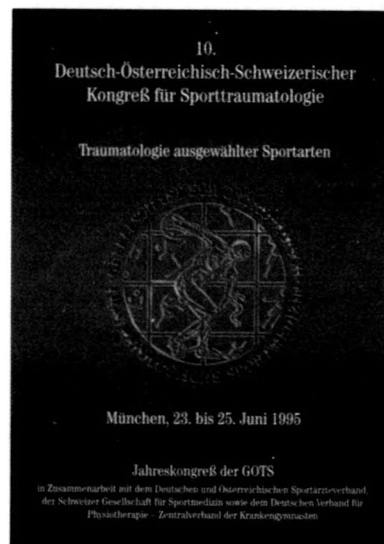
大阪労災病院スポーツ整形外科

史野根生

TEL 0722-52-3561

FAX 0722-59-7035

## ドイツ整形災害スポーツ医学会



会期：1995年6月23日（金）～25日（日）

場所：ミュンヘン市

日本での問い合わせ先：日本整形外科スポーツ医学会事務局

## 第84回 中部日本整形外科災害外科学会

会期：平成7年5月25日（木）、5月26日（金）

会場：大津プリンスホテル（大津市） 滋賀県大津市におの浜4-7-7 TEL 0775-21-1111

演題募集：主題および一般演題を公募いたします。

第一次演題申込締切：平成6年12月15日（木）

中部整災誌（37巻4号）に綴じ込みの葉書、または官製葉書に演題名、所属、氏名、住所を明記し、50円切手を貼付のうえ御投函下さい。第一次募集の葉書が到着後抄録用紙を送付致します。抄録用紙の発送は平成6年11月1日より開始致します。

第二次抄録締切：平成7年1月15日（日）必着。

所定の抄録用紙にタイプの上、募集要項に従ってご送付下さい。

特別講演：

- 1) Wolfhard Caspar (Department of Neurosurgery, University of Saarland, Germany)  
The Trapezial Plate Osteosynthesis : An advanced technology for anterior internal stabilization in cervical spine injuries and for the treatment of neck instability due to non-traumatic causes.
- 2) Robert L. Swezey (The Arthritis and Back Pain Center, Swezey Institute, U.S.A.)  
Rehabilitation of the Rheumatic Arthritis Patient.
- 3) Seppo Santavirta (Orthopaedic Hospital of the Invalid Foundation, Finland)  
Rheumatoid Spondylitis of the Cervical Spine. (仮題)
- 4) Gilles Walch (Orthopaedic Surgery and Traumatology Clinic, Centre Hospitalier Lyon-Sud, France)  
The Postero-superior Glenoid Impingement.
- 5) Martin M. Malawer (The Washington Cancer Institute, U.S.A.)  
Surgical Treatment of Bone and Soft Tissue Tumor. (仮題)

教育研修講演： 未定

- 予定主題：
- |                          |                          |
|--------------------------|--------------------------|
| 1. * 頸椎プレートの適応と限界        | 7. 若年者の高度変形性股関節症の治療      |
| 2. * 腰痛患者の理学療法とリハビリテーション | 8. 整形外科における免疫組織化学        |
| 3. * リウマチ性頸椎炎—手術療法と患者の予後 | 9. 投球障害（肩、肘）             |
| 4. * 肩関節不安定症の鏡視下手術       | 10. 脊髄、末梢神経のdouble crush |
| 5. * 良性骨腫瘍切除後の骨欠損の処理     | 11. 複合組織移植手術             |
| 6. 大腿骨頭壊死症の長期治療成績        | 12. 分娩麻痺の治療と予後           |

主題1～5（\*印）には特別講演の演者（主題1：Caspar, 2：Swezey, 3：Santavirta, 4：Walch, 5：Malawer）がpanelistとして参加する予定です。

その他の主題演題は公募演題数により一般演題とすることもあります。

連絡先：〒520-21 滋賀県大津市瀬田月輪町  
滋賀医科大学整形外科教室内  
第84回中部日本整形外科災害外科学会事務局  
TEL:0775 (48) 2252 (医局直通)  
FAX:0775 (48) 2254 (医局直通)

第84回中部日本整形外科災害外科学会  
会長 福田 眞 輔

## 第16期最初の総会開催される

平成6年8月 日本学術会議広報委員会

日本学術会議の第16期が平成6年7月22日(金)からスタートし、7月25日から7月27日までの3日間、第119回総会が開催されました。今回の日本学術会議だよりでは、総会の概要等についてお知らせします。

## 日本学術会議第119回総会報告

平成6年7月22日から、第16期が開始されましたが、この第16期会員による最初の総会である、日本学術会議第119回総会が、7月25日から27日までの3日間にわたって開催されました。

初日(25日)の午前は、辞令交付式が、総理大臣官邸ホールで行われ、210名の会員のうち海外出張中等の22名を除く188名の会員が出席しました。式は、村山内閣総理大臣、五十嵐内閣官房長官、石原官房副長官、文田総理府次長等の出席を得て行われ、第1部から第7部までの全会員の名前が読み上げられた後、会員を代表して最年長である中田易直第1部会員が、村山内閣総理大臣から辞令を受け取りました。この後、村山内閣総理大臣が「会員の皆様には独創性豊かな学術研究の発展等のため、総合的観点に立って学術研究に係わる諸問題の解決に御尽力いただきたい」とあいさつし、これに応じて、中田易直第1部会員が「微力ながら全力を尽くし、重要な職責を全うし、国民の期待に応えたい」とあいさつしました。午後は、日本学術会議講堂において、総会が開催され、会長、副会長(2名)の互選が行われました。その結果、会長には、伊藤正男第7部会員が、人文科学部門の副会長には、利谷信義第2部会員が、自然科学部門の副会長には、西島安則第4部会員が、それぞれ選出され、伊藤会長及び利谷副会長(西島副会長は海外出張中)からそれぞれ就任のあいさつを行いました。続いて、各部会が開かれ、各部の部長、副部長及び幹事の選出等が行われました。(第16期の役員については、別掲を参照)

2日目(26日)は、午前10時から総会が開催され、近藤前会長が海外出張中のため代理として川田前副会長が第15期の総括的な活動報告を行い、続いて、会員推薦管理会報告として、久保亮五委員長の代理として高岡事務総長が、第16期会員の推薦を決定するまでの経過報告を行いました。引き続き、事務総長から第16期会員対して実施した「第16期の日本学術会議が取り組むべき課題について」のアンケートの結果について説明がありました。総会終了後は、各運営審議会附置委員会、各部会、各常置委員会等が開催されました。また、夕方には、総理大臣官邸ホールにおいて、村山内閣総理大臣主催の日本学術会議第16期会員との懇談会が初めて開催されました。懇談会は、村山内閣総理大臣のあいさつで開会し、五十嵐内閣官房長官の発声による乾杯、伊藤会長の答礼のあいさつの後、懇談に入りました。来賓として、与謝野文部大臣、田中科学技术庁長官、吉田農林水産政務次官、藤田日本学士院院長ほか大勢の方が出席され、あふれんばかりの人々で歓談が続き盛会となりました。

3日目(27日)は、午前10時から総会が開会され、会長から「第16期活動計画の作成について」の申合せ案について提案があり、原案どおり可決されました。続いて、第16期の活動計画についての自由討議が行われ、各部長から各部会での意見が披露されるなど活発な発言がありました。総会終了後は、地区会議合同会議、各運営審議会附置委員会、各常置委員会等が行われました。その後、運営審議会が開催され、第16期の活動計画の素案作成のために、運営審議会構成員の中から起草委員を選出し、審議に入りました。



## 第16期日本学術会議役員

会 長	伊藤 正男 (第7部・生理科学)
	理化学研究所国際 フロンティア研究システム長
副会長	利谷 信義 (第2部・基礎法学)
	お茶の水女子大学 (生活科学) 教授
副会長	西島 安則 (第4部・化学)
	日本ユネスコ国内委員会会長

### 〔各部役員〕

第1部	部 長	中田 易直 (歴史学)
	副部長	戸川 芳郎 (哲学)
	幹 事	堀尾 輝久 (教育学)
	幹 事	森岡 清美 (社会学)
第2部	部 長	中山 和久 (社会法学)
	副部長	山口 定 (政治学)
	幹 事	兼子 仁 (公法学)
	幹 事	山中永之佑 (基礎法学)
第3部	部 長	柏崎利之輔 (経済政策)
	副部長	岡本 康雄 (経営学)
	幹 事	河野 博忠 (経済政策)
	幹 事	二神 恭一 (経営学)
第4部	部 長	伊達 宗行 (物理科学)
	副部長	竹内 郁夫 (生物科学)
	幹 事	井口 洋夫 (化学)
	幹 事	新藤 静夫 (地質科学)
第5部	部 長	内田 盛也 (応用化学)
	副部長	大橋 秀雄 (機械工学)
	幹 事	増子 昇 (金属工学)
	幹 事	松尾 稔 (土木工学)
第6部	部 長	志村 博康 (農業工学)
	副部長	北村貞太郎 (農業工学)
	幹 事	島田 淳子 (家政学)
	幹 事	平田 熙 (農芸化学)
第7部	部 長	渥美 和彦 (内科系科学)
	副部長	金岡 祐一 (薬科学)
	幹 事	入江 實 (内科系科学)
	幹 事	細田 泰弘 (病理科学)

### 〔常置委員会〕

第1常置	委員長	利谷 信義 (第2部)
第2常置	委員長	中塚 明 (第1部)
第3常置	委員長	村上 英治 (第1部)
第4常置	委員長	増本 健 (第5部)
第5常置	委員長	山中永之佑 (第2部)
第6常置	委員長	鹿取 廣人 (第1部)
第7常置	委員長	井口 洋夫 (第4部)

(注) カッコ内は、所属部・専門

## 第16期日本学術会議会員の概要について

この度任命された 210 人の第16期日本学術会議会員の概要を以下に紹介します。(カッコ内は第15期)

1 性別	男性209人	女性 1人
2 年齢別	45～49歳 1人	50～54歳 3人
	55～59歳 26人	60～64歳 93人
	65～69歳 72人	70～74歳 12人
	75～79歳 1人	
	最年長 75 歳 (74 歳)	
	最年少 47 歳 (54 歳)	
	平均年齢 63.6歳 (63.3歳)	

### 3 勤務機関及び職名別

(1) 大学関係	国立大学	59人
	公立大学	2人
	私立大学	111人
	公私立短期大学	2人
	計	174人
(2) 国立私立試験研究機関・病院等		9人
(3) その他	法人・団体関係	5人
	民間会社	6人
	無職	14人
	その他	2人
	計	27人

### 4 その他の分類

(1) 前・元・新別	前会員	82人
	元会員	3人
	新会員	125人
(2) 地域別 (居住地)		
	北海道	3人( 5人)
	東 北	9人( 8人)
	関 東	136人(133人)
	中 部	14人( 19人)
	近 畿	41人( 34人)
	中国・四国	3人( 5人)
	九州・沖縄	4人( 6人)

(注) 詳細については、日本学術会議月報 7 月号を参照

「日本学術会議だより」について御意見、お問い合わせ等がありましたら、下記までお寄せください。

〒106 東京都港区六本木7-22-34

日本学術会議広報委員会 電話03(3403)6291

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