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日本整形外科スポーツ医学会

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例えば

山○哲○ほか：投球障害肩の上腕骨頭病変—MRI と関節鏡所見の比較検討—．整スポ会誌，19：260−264, 1999.

Stannard JP et al : Rupture of the triceps tendon associated with steroid injections. Am J Sports Med, 21 : 482−485, 1993.

(2)単行書は著者名(姓を先とする)：書名．版，発行者(社)，発行地：ページ，発行年．

例えば

Depalma AF : Surgery of the shoulder. 4th ed. JB Lippincott Co, Philadelphia : 350−360, 1975.

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Caborn DNM et al : Running. In : Fu FH, ed. Sports Injuries. Williams & Wilkins, Baltimore : 565−568, 1994.

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教育研修講演

肩のスポーツ障害

Shoulder Injuries in Sports

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●Key words
肩，スポーツ，肩回施筋腱板
Shoulder : Sports : Rotator cuff

はじめに

近年，スポーツ人口の増加に伴ってスポーツによる肩の障害がクローズアップされ，肩の障害をもったスポーツ選手が整形外科医を受診する機会が多くなってきた。肩のスポーツ障害には多くの病態が含まれているが，外傷もしくはoveruseを原因として発症し，しだいに器質的な変化に発展していく。しかし，疼痛などの症状がスポーツをしている際にのみ起こることも多く，外来診察時に同様な症状を発現させることは難しく，障害部位を正確に決定しがたいことが多い。広範な可動域と多様な動きを要求される肩関節には，多くの関節と構成体があり，障害部位をできるだけ正しく診断するためには，肩関節機構などの機能解剖や運動時の筋活動などを理解して現病歴で患者からできるだけ障害に関する情報を集めてそれらを分析して評価した後に，画像診断や肩関節鏡検査などを行い，総合的に診断することが大切である。治療では各々の病態をよく把握して安静・運動制限・理学療法などの保存的療法を主体としてその病態に適した治療をまず行うべきであり，決して当初より手術的療法に拘泥すべきではない。

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ここでは肩のスポーツ障害のうち，主に投球障害肩を中心として述べる。

1．投球の各相

投球のphaseはwind-up phase，early cocking phase，late cocking phase，acceleration phase，follow-throw phaseの5つから成り立っている。障害によりどのphaseでどのような痛みが起こるのか，わかってきた。Bennett lesionではlate cocking phaseやfollow-throw phaseで疼痛が惹起され，インピンジメント症候群ではacceleration phaseで疼痛が起こる。しかし，投球は短時間で一連の動作が終結するために患者がどのphaseで疼痛が起こっているのかよく把握できていない場合も多い。ブロックテストも兼ねて，検者は投球動作をさせてみることも必要である。

2．インピンジメント症候群

Neerにより提唱されたインピンジメント症候群は，以前は棘上筋腱症候群と呼ばれていた。

その定義は「肩を挙上すると棘上筋腱，上腕二頭筋長頭腱が肩峰の前下線と衝突し，疼痛を起こす状態」とされている[1)]。診断法としてはインピンジメント徴候およびインピンジメントテストが陽性な症例で，stageにより3期に分けられている(Table 1)。棘上筋腱が存在するsupraspinatus outlet(烏口肩峰穹窿と肩関節上縁の間)が肩峰の形状や肩峰下骨棘

Table 1 インピンジメント症候群の病期分類[3)]

	主病変	好発年齢	鑑別疾患	臨床経過	治療
Stage I	浮腫と出血	25才以下	亜脱臼 肩鎖関節炎	可逆的	保存的
Stage II	線維化と腱炎	25-40才	凍結肩 石灰沈着性腱炎	活動により反復する痛み	時に滑液包切除と烏口肩峰靭帯切離術
Stage III	骨棘形成と腱板断裂	40才以上	頚椎症性根症 腫瘍	進行性	anterior acromioplasty 腱板修復

などにより狭くなると，症状を起こしてくるが，そのほかに腱板断裂，後方関節包の拘縮や関節包の弛緩などの機能的原因によってインピンジメント症候群が起こってくることが知られている。とくに投球障害肩では後方関節包の拘縮や関節不安定性があるためにインピンジメント症候群が起こってくることもあり[2)]，診断を進めていきながら，拘縮や不安定性に対する理学療法も同時に行う必要がある。

インピンジメント症候群の治療法としてはStage I，IIの大部分の症例では安静や腱板筋力訓練など保存的療法にて治癒するが，Stage IIIでは保存的療法が無効であれば，前方肩峰形成術の適応となる[3)]。鏡視下前方肩峰形成術もよく行われている。Royeはインピンジメント症候群に対して鏡視下前方肩峰形成術を行い，約80％が良以上であり，部分断裂がある群とない群では術後成績には差がなく，投球者は68％が，非投球者は90％が良以上であったが，野球やソフトボールのピッチャーは50％であったと報告している[4)]。

Walchにより最初に報告されたinternal impingement[5)]は肩関節を外転し，最大外旋すると関節面側腱板と関節窩後上方が衝突することにより起こってくる第2のインピンジメントである。前方不安定性が関係しているとの考えもあり[2,6)]，治療に難渋し，今後病態の解明が待たれる。

3．腱板断裂

腱板断裂は40歳以上に多発し，小さくても外力が働いていることが多い。腱板の中でも棘上筋が好発部位である。若年者においても野球などの肩をよく使う場合にみられると高沢は述べている[7)]。腱板断裂は完全断裂と不全断裂に大きく分けられる。Neerは腱板断裂の大部分はインピンジメント症候群によって起こっていると述べている[3)]。

理学所見としては肩関節痛，drop arm徴候陽性，拘縮，断裂部の陥凹触知，軋音，外旋筋力低下，Dawbarn sign，fluid sign，painful arc sign，one-finger resistance test，impingement sign & test，initial abduction test，dropping sign，lift-off sign(肩甲下筋腱断裂)，棘下筋萎縮などがあげられている。教科書にも多く記載されているdrop arm徴候陽性例は，われわれの経験では腱板完全断裂手術症例のうち40％しか存在しなかった[8)]。とくに発症時に外傷歴がない症例では17％のみ陽性であり，drop arm徴候のみで腱板断裂を診断してはならない。

補助診断法として単純X線では陳旧性完全断裂は上腕骨頭の上方移動や大結節の摩耗などが認められ，肩関節造影では完全断裂で造影剤が肩関節腔内から肩峰下滑液包内へと流出する(Fig. 1)。また，不全断裂のうち，関節面断裂は肩関節造影で診断可能である。超音波検査により腱板の菲薄化や消失の所見があると完全断裂と診断される[8)]。不全断裂も56～93％が診断可能とされている(Fig. 2)。しかし，正しく診断するためには技術の習熟や明確な診断基準を確立することが必要である。最近腱板断裂の診断に最もよく用いられている検査法はMRIであり，完全断裂の診断率は90％を超えている[9)]。MRIにより今まで診断が困難であった不全断裂も80％以上の症例が診断される(Fig. 3)。

Fig. 1 肩関節造影
完全断裂。

腱板断裂の治療法として保存的療法と観血的療法にわけられる。安静，ステロイド剤やヒアルロン酸製剤の注入，理学療法などの保存的療法が試みられる。手術の適応としてPostは，約3ヵ月間保存的に治療しても軽減しない疼痛と肩関節機能の喪失としている[10]。しかし，高いレベルでの競技への復帰を考えると保存的療法で無効ならば早期に観血的療法を考慮すべきである。

手術法としてはtendon to boneであるWilson法やMcLaughlin法，側側縫合や，arthroscopically-assisted mini open repairなどが行われている。競技者に対する腱板断裂の手術法としては，Tiboneは15人のスポーツ選手の完全断裂に対して腱板修復術と肩峰形成術を行い，10名が同じスポーツレベルに戻ったと報告している[11]。部分断裂の症例に対して，Andrewsは鏡視下にdebridementのみを行って短期的には比較的良好と報告し[12]，Tiboneは30名に肩峰形成術と断裂部の切除術を行い，15名が競技に復帰したと報告している[11]。しかし，ADLで痛みを訴えた症例はわずか6名であった。部分断裂に対する鏡視下手術でスポーツへの復帰をみると，外傷で起こった症例よりもoveruseで起こった症例は予後が悪いとされている[13]。

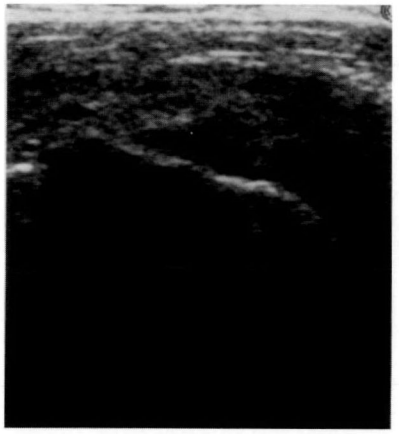

Fig. 2 腱板不全断裂の超音波像
棘上筋腱表層の不整を認める。

Fig. 3 腱板不全断裂のMRI像
表層断裂例。

4. 肩不安定症

肩不安定症も肩スポーツ障害の原因として重要である。その分類として脱臼方向(前方，後方)，脱臼の程度(亜脱臼，脱臼)，原因(外傷性，非外傷性，使い過ぎ)および期間(急性，反復性，陳旧性)などにより分類されていたが，最近はTUBS(traumatic onset, unidirectional anterior with a bankart lesion responding to surgery)およびAMBRI(atraumatic in etiology, multidirectional in nature with bilateral shoulder findings, rehabilitation as the appropriate

treatment, and rarely surgery in the form of an inferior capsular shift)に分類されることがある。

1）外傷性肩関節脱臼

TUBSである外傷性脱臼後に再脱臼する頻度は若年者で高いことが知られている。Hoveliusは各年齢層ごとの再脱臼率について10年間の前向き研究を行い，初回脱臼時に25歳以下であった患者は2回以上再脱臼する頻度は60～70％としている[14]。初回脱臼の治療法としては一般に保存的療法が行われていたが，Arcieroの外傷性肩関節脱臼症例に対する保存的療法もしくは鏡視下手術療法を行った症例の再脱臼率の比較から，鏡視下手術療法が注目を集めている[15]。当科では①整復，②三角布固定を3週間，③抵抗運動で可動域・筋力(isometric)強化，④外転外旋位は少なくとも6週間禁止，⑤痛みなく，正常筋力に回復してapprehension testが陰性になればスポーツへ復帰，としている。

2）反復性肩関節脱臼

反復性肩関節脱臼は初回脱臼後に軽微な外力にて肩関節が脱臼するものである。

肩関節不安定症の理学所見としては，anterior apprehension testやposterior apprehension test，Sulcus signなどがある。

反復性肩関節脱臼に対する手術療法としてはBankart法，Bristow法，modified inferior capsular shift法，鏡視下肩関節制動術など多くの手術術式が考案されてきている。われわれは，modified inferior capsular shift法を行っているが，59例中再脱臼は2例，亜脱臼は1例のみであった。外旋の患健側差は平均15°であり，スポーツを行っていた45例中34例が元のスポーツへ復帰していた。外旋可動域が不足してスポーツへ復帰できなかった症例は野球，バレーボールの3例であった。本法を行ううえで，再脱臼せずに外転位での外旋制限を少しでも軽くする方法を考える必要がある。2例は術前できなかったスポーツを術後再開している。

Bigliani らはanterior-inferior capsular shift法によって92％がmajor sportsへ復帰したが，エリートの投球者で同じレベルへ復帰できたのは50％であったと報告し[16]，MontgomeryとJobeらはhorizontal capsulotomyとsuture anchorsを用いて手術を行い，同じスポーツで同じレベルへの復帰は81％であり，同じスポーツに復帰できなかったのはわずか6％だったと報告している[1]。

鏡視下Bankart repairは広く行われているが，再脱臼率が高いという欠点があった。最近，手術法の改善や術後固定期間などが改善されて再脱臼率も低くなってきている。

NeerやJobeは前方亜脱臼とインピンジメントは合併する可能性があることを述べている[3,17]。先に述べたように前方亜脱臼があるとインピンジメント症候群が引き起こされることが知られてきた。そのため，両者は①インピンジメント症候群のみ，②外傷による前方不安定症による2次的なインピンジメント症候群，③関節弛緩症による前方不安定症による2次的なインピンジメント症候群，④前方不安定症のみ，と分類できる[3]。投球選手の不安定症があると，不安定症から亜脱臼，インピンジメントそして腱板断裂へ移行するとの指摘もある[17]。インピンジメントサインと前方不安定性が存在するとき，その鑑別としてrelocation testが有用である[2]。

5. SLAP lesion

Andrewsらは投球障害における上方関節唇損傷を報告し[18]，SnyderはSLAP lesion(superior labrum from anterior to posterior in the relation to the biceps tendon anchor)としてその形態によりType I～IVの4つに分類している[19](Fig. 4)。SLAP lesionの原因としては反復性肩関節脱臼の症例にも多く認められるが，第1には，投球動作のフォロースルー時に上腕二頭筋長頭腱による圧迫力が上方関節唇に働くこと，および第2には肩関節を軽度屈曲した外転時に手をつく動作をしたときに上腕骨頭による圧迫力が上方関節唇に働いて損傷を起こすと考えられている。

Snyderは肩関節鏡を施行した2,375例中140例にSLAP lesionを認めている[20]。Type IIが最も多く55％で，続いてType I 22％，Type IV 10％，Type III 9％であった。症状は疼痛であり，機械的なひっかかり感や違和感が存在した。合併した所見としては腱板部分断裂が29％，完全断裂11％，Bankart

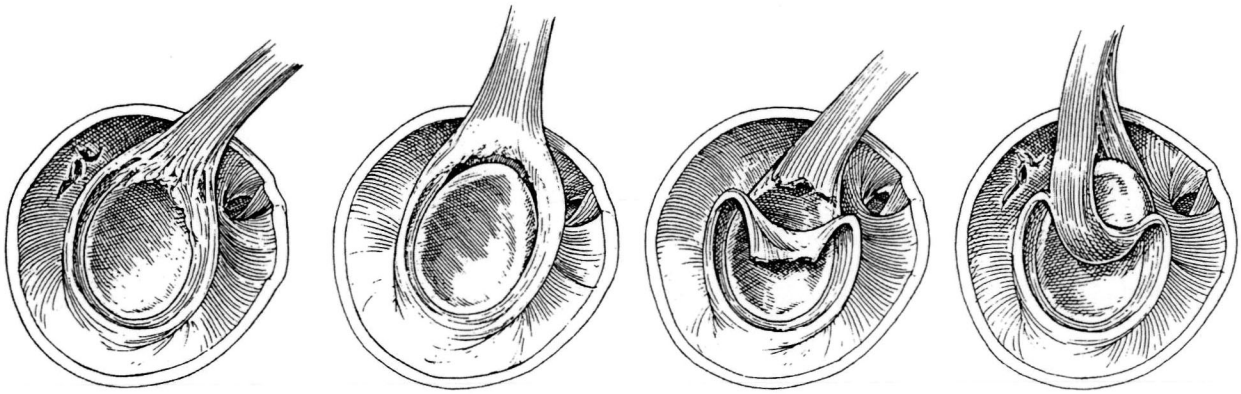

Fig. 4 SLAP lesionの分類[19)]
Type Ⅰ：上腕二頭筋腱付着部は正常で上方関節唇のfrayingと変性がある。
Type Ⅱ：関節窩上方からの関節唇と上腕二頭筋腱の病的剥離。
Type Ⅲ：膝の半月板バケツ柄断裂同様の上方関節唇の縦断裂。
Type Ⅳ：上方関節唇の縦断裂が上腕二頭筋長頭腱まで伸びる。

lesionが22％などであった。

反復性肩関節脱臼の手術時にはよくSLAP lesionを認めるが，処置しなくても後でこれが問題となった症例は自験例にはない。SLAP lesionがどこまで症状を出すのかまだ十分には解明されていない。

理学所見としてはO'Brien testは肩関節を90°屈曲位で10～15°内転して，上肢に抵抗を加えるとthumb downである回内位で疼痛が起こるが[21)]，thumb up(回外位)では疼痛が軽減もしくは消失する。最近，Mimoriらは新しいテストを考案している[22)]。

画像診断法としてはMR関節造影を行うと上方関節唇と関節窩上縁との間に造影剤が入っていく(Fig. 5)が，正常な状態でもその間には間隙はあり，判断が困難なことがある。

治療法としてはType Ⅰではshavingが行われ，Type Ⅱであればabrasionした後，suture anchorなどによって固定する方法と切除する方法が報告されている。Type ⅢおよびType Ⅳはdebridementもしくは修復されている。

以上，比較的よくみられる肩のスポーツ障害について述べたが，近年の画像診断の進歩や肩関節鏡検査の発達によりスポーツ障害肩に対する診断法は大きく変わってきた。これにより多くの情報が画像検査や鏡視により得られるが，診断をするにあたって問診，理学所見，画像所見，鏡視所見を総合的に解釈してそれらが臨床所見と合致するか検討する必要がある。また，治療にあたっては，各々の病態をよく把握したうえで保存的療法もしくは手術的療法を選択すべきである。

Fig. 5 MR関節造影
SLAP lesion。

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教育研修講演

機械受容器の再生からみた前十字靱帯再建術

ACL Reconstruction from the Viewpoint of Regeneration of Mechanoreceptors

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はじめに

前十字靱帯(以下ACL)はスポーツ時のジャンプの着地，急激な方向転換等の動作で比較的簡単に切れる。近年のスポーツ人口の増加と診断技術の向上，MRI等の診断のための器械の整備に伴い，ACL損傷数は増加している。アメリカの統計によれば，毎年95,000人がACL損傷を被り，約50,000人に再建術が行われている[1]。したがってACLの解剖や，機能に関する研究もさかんに行われ，再建術の予後も徐々に良好になっている。しかしその再建術の主眼は如何に力学的に強い紐を作成するかであり，ACL内のメカノレセプターの存在やその機能にはあまり注目されてこなかった[2]。しかし，近年，動物のみでなく，ヒトのACL内に数種のメカノレセプターの存在が組織学的に証明され，その分類にも焦点があてられるようになった[3~7]。ACL機能不全膝における膝くずれ，半月板断裂，進行する動揺性と変性変化が単にACL不全に基づく運動異常により生じるのではなく，メカノレセプターからの情報のフィードバックが生じないためと，1982年Kennedyらがすでに発表しているが[8]，彼らの仮説がいっそう真実味を帯びてきている(Fig. 1)。

本論文においては，現在までに明らかになっているメカノレセプターの存在とその機能を正常ACL，再建ACLに分け論じる。

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1. 正常ACLにおけるメカノレセプターの解剖学的証拠

メカノレセプターの種類は，その染色方法に差異があるため，報告者により異なるが，大きくルフィニ小体，パチニ小体と自由神経終末に分類されることが多い[3]。ルフィニ小体は卵形を呈し，50×500 μの大きさで，主に伸長に対して反応し，パチニ小体より多数存在するといわれている。パチニ小体は厚い層状カプセル構造で，その大きさは150×600 μであり，圧迫に対して反応するレセプターである(Fig. 2)。自由神経終末の数はメカノレセプターに比し，多数であり，力学・生化学刺激に感受性を有している。ほとんどのメカノレセプターは滑膜下組織に存在し，ACLの付着部付近に優位に存在している。しかし猫のACL内のメカノレセプターの総数は6から20しか存在しないとの報告もある[4]。またRaunestらによれば，成熟羊のACL内にはパチニ小体は13.6±5.3個，ルフィニ終末は8.9±3.2個存在したが，ルフィニ小体は4.9±2.1個観察.され，靱帯中央部より靱帯付着部に有意に存在する

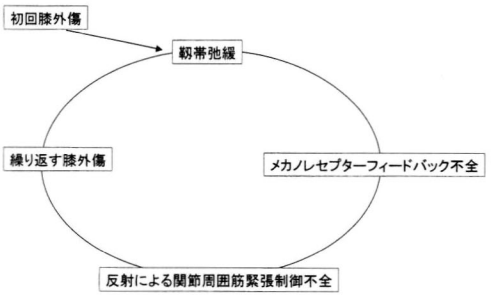

Fig. 1 関節動揺性に及ぼす神経系の関与[8]

Fig. 2 ヒトACL remnant内のメカノレセプター(パチニ小体)

ことを報告し，分類法によりその数は少し異なってくる[9]。いずれにしても，その数は多数というより少数である。

ヒトにおいてはKrauspeらによれば3歳の男児のACL内に17個のルフィニ小体が観察されており，これはヒトにおいて報告されたなかでも最も多いメカノレセプター数である[6]。一方総数ではなく，全靱帯領域に占める割合ではZimnyらによれば2.5％，Schutteらによれば1％と報告されており，ヒトのACLにおいてもメカノレセプター総数は限られていることを示している[10,11]。ACL断裂後数ヵ月経過してもACL remnant内にもメカノレセプターが残存していることがわれわれの研究でも判明している(Fig. 2)。

2. 再建ACL内に再生メカノレセプターの解剖学的証拠

再建したACLにメカノレセプターが再生して機能するか否かは，再建ACLの特性の極めて重要な問題である。すなわち再建したACLが単に力学的な紐としてのみしか機能しえないのか，あるいは再生したメカノレセプターを介して正常なACL同様，関節位置覚あるいは関節周囲筋の緊張にも影響を与えることができるかはACL再建の意義を考えるうえで興味深い。

1) 動物の再建ACL

Dentiらは羊のACL再建を行い，自家膝蓋腱を再建材料として使用した場合にはメカノレセプターの再生が生じること，一方，人工靱帯を再建材料として用いた場合にはメカノレセプターの再生が認められないことを報告した[12]。Auneらはラット自家膝蓋腱を用いたACL再建靱帯内にニューロペプチド免疫組織化学染色で陽性の末梢神経を観察し，再生ACL内に末梢神経が再生することを示した[13]。また，Wadaらは家兎のACL再建を行い，再生材料として用いた膝蓋腱に含まれる数のメカノレセプターと有意差のない数のメカノレセプターが再建ACLに観察されたと報告した[14]。しかし，メカノレセプターの再生機序に関しては不明の点が多い。ACL再建材料内に元来局在していたメカノレセプターに再生神経が誘導されるように伸長していき，機能的結合を得るのか(Neurotropism説)，あるいは再建材料内に元来存在していたメカノレセプターとはまったく別の部位に新しいメカノレセプターが再生するのか否かは判っていない。もし前者が正しいのであれば，生体力学的観点のみでなくメカノレセプターの再生の観点からも元来メカノレセプターを多数有する再建材料を選択すべきである。人工靱帯にはメカノレセプターは存在しておらず，この視点からは再建材料としてきわめて不利になる。

2) ヒト再建ACL

再建後良好に機能しているヒトACL内にメカノレセプターが再生しているか否かを調べることはほとんど不可能に近い。関節鏡視下に生検を行っても，採取しうる組織量には限界があり，この組織内に神経組織やメカノレセプターが存在しないからといっても，メカノレセプターが再生していないことを意味しない。Auneらは自家膝蓋腱を用いた10人のACL再建者に術後5～7ヵ月で生検を行い，神経組織の存在しないことを報告したが[13]，上記の理由よりメカノレセプターの再生が再建ACLに生じないことを積極的に支持するものではない。一方Dentiらは，再建ACLが緩んだため術後9年と10年に再々建術を行った2症例の採取した再建ACLに正常形態のメカノレセプターが存在していたと報告した[12]。ヒト再建ACLにもメカノレセプターが再生

する可能性を強く支持する報告ではあるが，正常に機能している再建ACLにも同様に正常メカノレセプターが再生していることを完全に保証するものではない。したがって正常に機能しているヒト再建ACL内にメカノレセプターが再生しているか否かは，解剖学的にメカノレセプターの存在を証明する方法以外の方法を考慮すべきであろう。

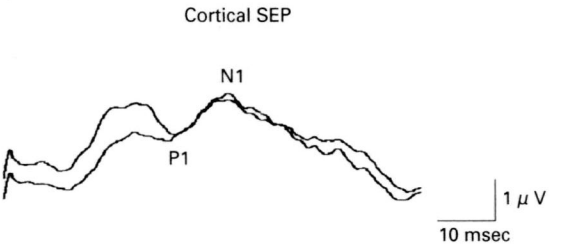

Fig. 3 ACL再建後24ヵ月の20歳女性症例のSEP[23]

3. ACL内のメカノレセプターの機能

1）動物実験

膝を他動的に動かす(とくに伸展する)ことで，ACL内のメカノレセプターに連続する神経線維からの電気活動が観察された[15]。またACLにひっかけたワイヤーを130～150ニュートンで引っ張りACLを物理的に刺激することで，筋電図上膝屈筋の活動性が認められたという報告のある一方，認められなかったという報告もあり，一定の結論は得られていない[16, 17]。しかし，ACLにひっかけたワイヤーではたしてACL内のみのメカノレセプターを純粋に機械的に刺激できるのかに関して疑問が呈せられている[18]。ACLに100ニュートン以上の引っ張り力が加われば，大腿・脛骨間にも動きが生じ，他の靱帯や関節が刺激を受け，末梢神経や膝屈筋からの活動電位はACL内のみのメカノレセプターの刺激により生じたことにはならない。この点を考慮し，MiyatsuらはACLの脛骨付着部をブロックで切離し，このブロックを30ニュートンで引っ張り，大腿四頭筋，膝屈筋から筋電図上の変化が生じることを報告した[19]。これら以外にもACLを電気的に刺激し，大脳皮質体性感覚誘発電位(以下SEP)が生じるか否かを調べることでACL内の神経線維が大脳まで連絡しているかを調べることが可能である。Barrackらは自家膝蓋腱を用いて再建した犬のACLを直接電気刺激し，6ヵ月後6匹中2匹にSEPが記録されたと報告した[20]。当教室の栗岡らは家兎の膝屈筋腱を用いた再建ACLを電気刺激し，術後1年で8匹中5匹に陽性SEPが観察されたと報告した[21]。これらの報告は末梢神経線維が再建ACL内に再生してくることを示している。血管網の再生に伴い，神経線維は滑膜組織とともに再生する可能性が高いが，切断された末梢神経の中枢端から発芽する再生神経は末梢端が近傍に存在しない限り，伸長しうる距離は数ミリメートルと限られており，どのような機序で約20 mmの再建ACL全域に再生するのかを明らかにすることが今後の課題であろう。

2）臨床例

ACLを直接電気刺激することでSEPが記録しうることがヒトACLでも証明された。ヒト正常ACL刺激で陽性SEPが9人中全例に認められることをPitmanらが証明した[22]。われわれはヒトACL remnant刺激では32人中15人に，再建ACLでは23人中22人に陽性SEPが記録されることを報告した(Fig. 3)[23]。しかし陽性SEPは単に神経線維の存在を意味するのみで，ACL内の神経線維やメカノレセプターがACLの圧迫伸長に対して機能することを意味しない。そこで関節鏡手術中に，正常ACLを3.9ニュートンの力で，200回機械刺激し，SEPを記録した[24]。正常ACL刺激では19例中19例に再現性のある陽性のSEP波形が得られた。これはすなわち，ACLに圧迫伸長の負荷が加わると，ACL内のメカノレセプター，末梢神経が発火し，電気的信号が中枢に向かって伝達されることを表わしており，ヒトACLにもセンサーの機能があることを意味している。また再建ACL刺激でも再建後13ヵ月以上経過例では38例中36例に陽性SEPが認められ，1年以上経過するとACL内に機械刺激に反応する神経線維あるいはメカノレセプターが再生することを示唆している。

3）ACL内のメカノレセプター数と膝の固有受容機能との関連

ヒトACL内のメカノレセプターの意義を調べる

ことは最も重要な課題である。膝の固有受容機能を調べる方法として①関節位置覚の誤認角度，②他動的に膝を動かした時の認知時間のズレ，を調べる方法が一般的である。われわれはその機能を調べる方法として関節位置覚誤認角度を用いている。

ACL内のメカノレセプターが膝固有受容機能に関与しているか否かを調査するためには，正常人の膝固有受容機能すなわち関節位置覚の精度とそのACLのメカノレセプター数との関係を検討するのが最も直接的である。しかし，位置覚を調べた後に正常の人のACLを採取することは許されることではなく不可能である。当教室のAdachiらはACL再建時，大腿骨側と脛骨側間に連続性を認めるACL remnantが存在していれば，可及的に一塊として採取し，その中のメカノレセプター数と術前の関節位置覚との関係を調べた[25]。神経自由末端を除いたメカノレセプターの総数はACL remnant内に平均約17個存在しており，メカノレセプター総数と関節位置覚誤認角度には相関が認められることを報告した。総数が大きいほど関節位置覚誤認角度は小さい傾向にあることが判明し，ACL remnant内のメカノレセプターは関節位置覚にある程度の役割を果たしているものと考えられた。

また，当教室のIwasaらは，ACL再建後に関節位置覚誤認角度がどのように改善するか調査した[26]。経時的に改善する傾向があり，十分に改善するには約18ヵ月以上必要とすること，誤認角度の改善と膝関節の動揺性の改善が深く関与していることを明らかにした。

まとめ

ACLのメカノレセプターにどのような意義があるのかはいまだ十分には解明されていない。膝に有害な非生理的外力が急に加わった時，ACL内のメカノレセプターが機能し，反射的に筋の緊張が変化し，幾分なりともACLが断裂しない方向に作用するのか，またその際の外力の大きさと速度がどのように関連するのかを今後詳細に検討する必要があろう。

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教育研修講演

医学生のラグビー外傷と安全対策

Injuries and its Prophylaxis in Rugby Football Players of Medical Students

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はじめに

スポーツ外傷を予防し，治療すべき立場にある医師のその育成機関である大学医学部や医科大学でラグビー外傷が多く発生し，とくに重症の外傷が多いことが以前よりラグビー協会関係者の間から指摘されていた。1995年より関東ラグビーフットボールメディカルソサエティで調査が行われた。その間，1997年8月東日本医科大学大会準決勝で順天堂大学医学部ラグビー部6年生の頚髄損傷事故が発生した。この事故をきっかけに日本整形外科スポーツ医学会を中心に，全国医学部スポーツ協議会ラグビー安全対策委員会 Working Groupが結成された。委員会を中心にラグビー外傷と安全対策について全国医学部学生につき調査が行われた。

調査の目的は医学生ラグビー外傷の調査と重症外傷の予防対策の検討である。

1. 方　法

ラグビー外傷に関するアンケートを作成し(Table 1)，全国の医学部学生のラグビー外傷について調査を行った。アンケートはラグビー歴，ポジション，外傷名のほか，外傷の生じた日時，場所，受傷機転，考えられる受傷原因，ラグビーへの復帰状況などを記入してもらう内容である。各大学医学部および医科大学ラグビー部にアンケート用紙を発送し，1993年から5年間のラグビー外傷の調査を依頼し，集計し，事故防止対策につき検討した。

2. 結　果

回収総数は193名分で，東医体129名，西医体64名の解答があった。アンケート回収率は東医体33校中22校(66.7％)，西医体校40校中21校(52.5％)，計73校中43校(57.5％)であった。

重症外傷の定義として，入院または手術的加療を要した外傷を重症外傷と定義した。重症外傷の発生率は，193例の外傷中61例(31.6％)であった。

(1) **外傷の種類**：骨折39.9％，靱帯損傷15％，脱臼13.5％，捻挫6.7％などで，骨折，靱帯損傷，脱臼，切挫創，捻挫の順に多かった(Fig. 1)。

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Table 1　ラグビー外傷・障害調査用紙

（１９９３年１月－１９９７年１２月）
（医師を受診した者に限る）

１）所属：＿＿＿＿＿＿＿＿＿＿大学＿＿＿＿＿＿＿＿＿＿学部
２）イニシャル：
３）生年月日：１９　　年　　月　　日
４）外傷名：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
５）学年：　　年生、　　身長：　　cm、体重：　　kg
６）ラグビー歴：小、中、高、大より　　年　　カ月
７）ポジション：＿＿＿＿＿＿＿＿＿＿（NO.　　）
８）受傷日時：１９　　年　　月　　日　AM、PM　　時　　分
９）受傷場所（具体的に）：＿＿＿＿競技場、＿＿＿＿グランド、校庭
その他：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
１０）受傷時：試合：公式試合、練習試合、紅白戦、合宿試合
練習：合宿練習、一般練習
その他：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
１１）受傷時の防具の有無：ヘッドギア：　有　　無
マウスガード：　有　　無
その他：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
１２）手術の有無と方法（具体的な手術名を記入して下さい）
有、無、方法：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
１３）入院期間：　　ヵ月間、　　週間、　　日間
１４）ラグビー復帰までの期間：　　ヵ月間、　　週間、　　日間
１５）ラグビー復帰状況：練習に参加、試合に参加、公式戦参加、
ラグビーを断念、スポーツを断念、
その他：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
１６）本人の過去の病歴：外傷：＿＿＿＿＿＿＿＿＿＿＿＿
有、無、疾病：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
１７）受傷状況（受傷機転）：タックルされ、タックルして、スクラム、
モール、ラック、その他：＿＿＿＿＿＿＿＿＿＿＿＿＿＿
１８）考えられる受傷原因：体調不良、練習不足、既往歴あり、体力差、未熟
その他：＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
１９）障害互助会（登録者障害見舞金制度）への報告：　有　無
２０）その他、参考になる点が有れば記入して下さい。
２１）記入者名：＿＿＿＿＿＿＿＿大学：氏名＿＿＿＿＿＿＿＿＿＿
連絡先：＿＿＿＿＿＿＿＿＿＿＿＿
電話：＿＿＿＿＿＿＿＿＿＿＿＿
２２）記入年月日：１９９　年　　月　　日

(2) **受傷部位**：下肢の外傷が多く，次いで頚部，顔面に，次に肩甲体，上肢と続いていた(Fig. 2)。

(3) **部位別の外傷**：骨折は77例で顔面骨折が最も多く，次に上肢，下肢に多い傾向にあった(Fig. 3)。

(a) 顔面の骨折は，計22例(28.6％)で，鼻骨が8例，頬骨が6例，眼窩底3例，下顎骨2例，その他が3例であった。

(b) 上肢の骨折は16例(20.8％)で，手指が12例(15.6％)と多く，前腕2例，肘関節部，上腕各1例であった。

(c) 下肢の骨折では15例(19.5％)中9例が足関節周辺の骨折で，その他に，下腿骨，足趾

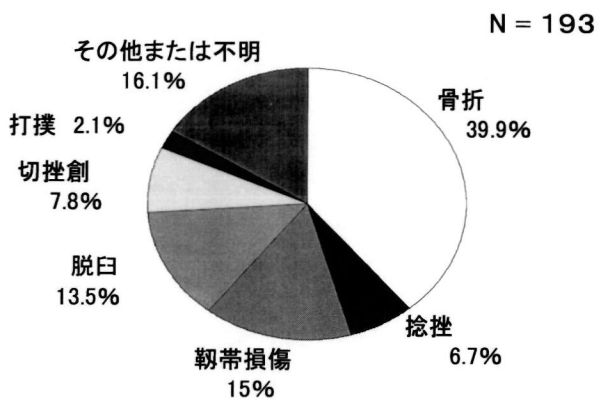


Fig. 1　外傷の種類
骨折，脱臼，靱帯損傷が多い。

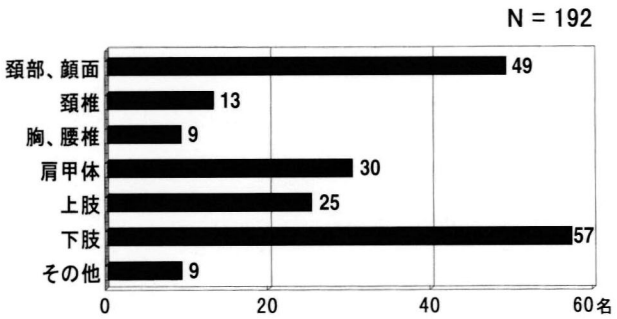


Fig. 2 受傷部位
下肢のほか頚部，顔面に外傷が多い。

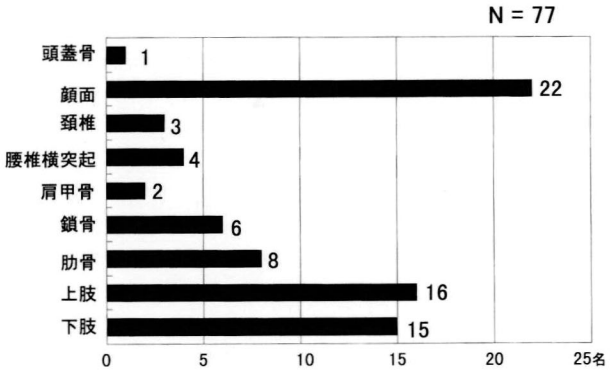


Fig. 3 骨折部位
顔面，上，下肢に骨折が多い。

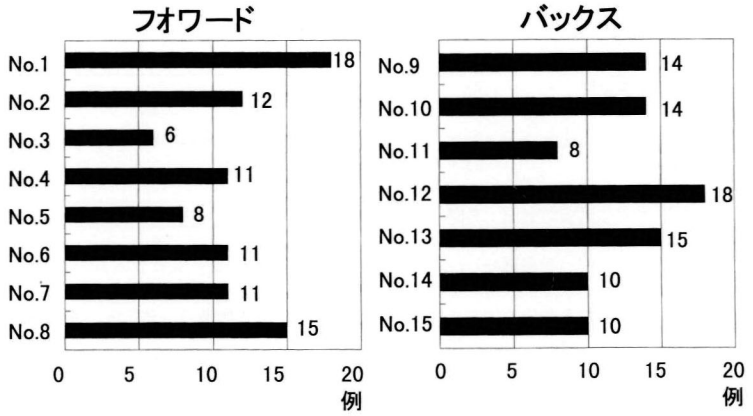


Fig. 4 ポジション別受傷者数
1，8，12，13番に受傷者が多い。

各2例，大腿骨，膝蓋骨が各1例であった。

(d) 靱帯損傷全体は計29例中膝関節が22例(75.9％)，足関節が5例，手指が2例であった。

(e) 膝靱帯損傷は22例中，内側側副靱帯損傷が8例，前十字靱帯損傷が7例，後十字靱帯損傷が2例，その他5例であった。

(f) 脱臼は計26例あり，肩関節が12例，肩鎖関節が10例，手指の関節が4例であった。

(4) **受傷時学年**：1年生28例(15％)，2年生31例(16％)，3年生49例(26％)，4年生43例(22％)，5年生27例(14％)，6年生14例(7％)で3，4年生(48％)に外傷が多くみられた。

(5) **受傷選手のラグビー歴**：受傷例192例中大学生から始めた者126例(65.6％)，高校生から始めた者55例(28.6％)，中学生から始めた者9例(4.7％)，小学生から始めた者2例(1％)と大学生からラグビーを始めたケースが圧倒的に多かった。

(6) **ポジション別受傷者数**：フォワードとバックスの差ではフォワードが92例(51.1％)，バックスが89例(48.9％)とときに大きな差は認められなかった。ポジション別の受傷者数はフォワードではプロップの1番が18例(9.8％)，フッカー(2番)が12例(6.5％)と多く，またNo.8が15例(8.2％)と多かった。バックスではあまり差はみられないが，センターが12番18例(9.8％)，13番15例(8.2％)とバックスのなかでも最も外傷が多かった(Fig. 4)。

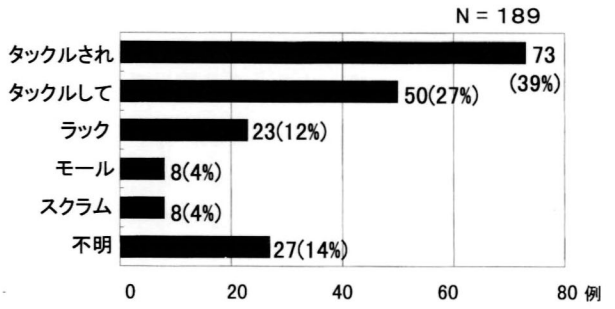


Fig. 5 受傷プレイ
タックルに関連した受傷が多い。

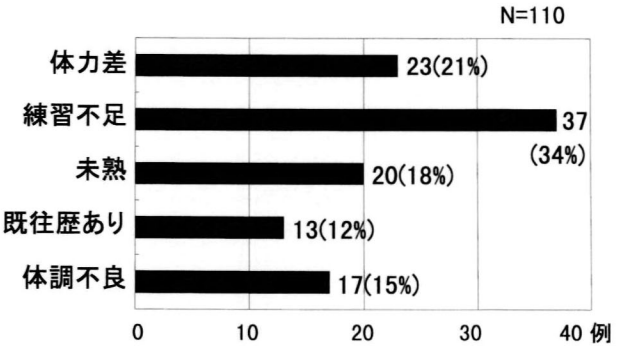


Fig. 6 考えられる受傷原因
練習不足，体力差，未熟，体調不良などが多い。

(7) **受傷状況**：公式試合(39.7％)が最も多く，次に一般練習(29.6％)，練習試合(23.3％)がそれに次いでいた。

(8) **受傷プレイ**：タックルされての受傷(38.6％)が最も多く，タックルしての受傷(26.5％)と併せて，タックルに関係した受傷原因が65.1％と最も多く，この点がラグビー外傷の予防のキーポイントとなると考えられる(Fig. 5)。

(9) **考えられる受傷原因**：アンケートにおいてそれぞれの受傷原因を受傷者に回答してもらったところ，練習不足(33.6％)，体力差(20.9％)，未熟(18.2％)，体調不良(15.5％)，既往歴あり(11.8％)という答えで，これは医学部の学生が学業に忙しく十分な練習ができない点，体調の不十分な状況で練習し，試合をしていることが明らかとなり，医学部学生のラグビー外傷の特徴と考えられた(Fig. 6)。この外傷の原因のさらなる分析がラグビー外傷の予防に重要と考える。

(10) **手術について**：計188例中手術を行った者61例(32.4％)で，このうち骨折の観血的整復固定術27例(14.4％)，皮膚縫合術18例(9.6％)などが多くみられた(Fig. 7)。

(11) **最近の医学生のラグビー頚髄損傷例**[1]：1984年Y大学2年生より1998年N大学2年生まで14年間に計6例の頚髄損傷が報告されている(Table 2)。

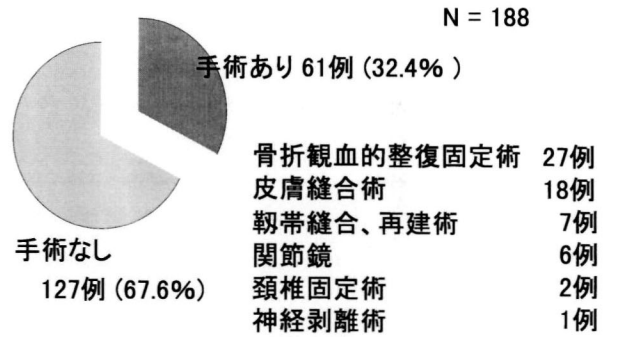


Fig. 7 手術を受けた頻度と手術の種類

3. 症例の報告

症例1：23歳，男性，K大学医学部1年生。
ポジション：No.8。
ラグビー歴：3ヵ月。

経過：1993年5月26日，ラグビー試合中，タックルして頚部を屈曲位に強制し受傷。直後より四肢麻痺となる。某病院にて，頚髄損傷の診断にて母校大学病院ICU入院(Fig. 8)。同日クラッチフィールド牽引施行，入院時所見C6下位型の四肢麻痺，上腕二頭筋まで筋力あり，以下完全麻痺。6月18日，第5頚椎亜全摘し骨片による頚髄の圧迫を除去。第4より第6頚椎まで骨移植し頚椎前方固定術施行。7月14日，頚椎装具着用。術後筋力は手関節の動きまで改善，知覚障害も軽度改善。7月23日，リハビリ目的にて国立村山病院へ転院。現在，国家試験に合格し，車椅子にて母校の病院にて精神科医として

Table 2 医学生の頚髄損傷例[1)]

症例	受傷時学年・年齢	ポジション（身長，体重）	ラグビー歴	受傷原因	受傷部位（損傷型）	就労状況
1) S.59 Y大学	2年生·25歳	No.8（180cm, 85kg）	5年6カ月	ラック（公式試合）	C4/5脱臼骨折（屈曲損傷）	精神科医
2) H.3 K大学	1年生·24歳	No.8（172, 68）	3カ月	ラック（合同練習）	C4/5脱臼骨折（屈曲損傷）	精神科医
3) H.5 S医科大学	3年生·22歳	プロップ（178, 80）	2年4カ月	スクラム（合同練習）	C4/5脱臼骨折（屈曲損傷）	精神科医
4) H.7 K大学	3年生·23歳	ロック（171, 68）	2年4カ月	タックル（公式試合）	C5/6脱臼骨折（屈曲損傷）	学生
5) H.8 J大学	6年生·23歳	プロップ（169, 78）	5年4カ月	スクラム（公式試合）	C4/5脱臼骨折（屈曲損傷）	精神科医
6) H.10 N大学	2年生·19歳	プロップ（175, 78）	1年3カ月	スクラム（合同練習）	C5/6脱臼骨折（屈曲損傷）	学生

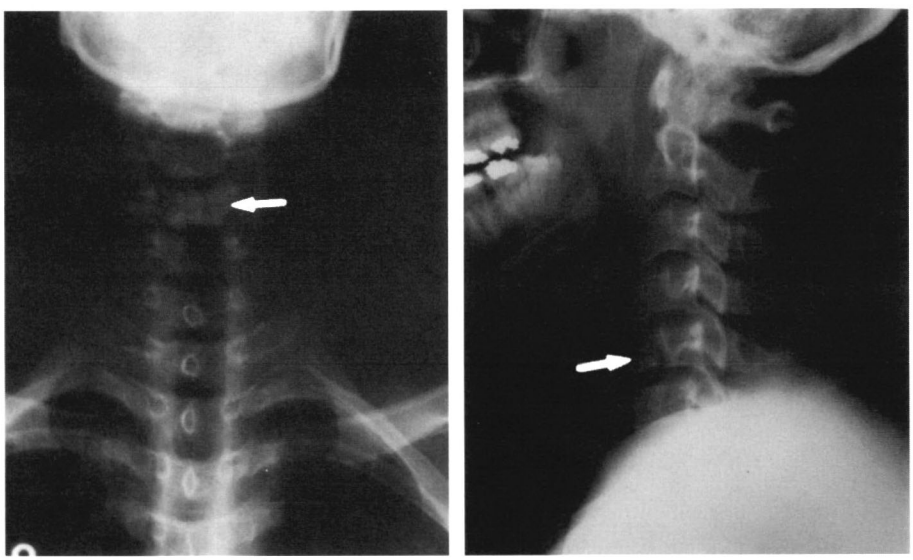


Fig. 8 症例1：受傷時頚椎側面像
第5頚椎圧迫骨折を認める。

勤務中。

症例2[2)]：23歳，男性，J大学医学部6年生，身長169 cm，体重78 kg。

ポジション：右プロップ。

既往歴：とくになし。

運動歴：中学高校時代，卓球。

ラグビー経験：6年。

経過：1996年8月4日14時10分，東日本医科大学大会ラグビー部門準決勝の対新潟大学医学部戦試合開始10分後にスクラムを組んだ際に組み遅れ，頚椎屈曲位のままスクラムが崩れて受傷。受傷直後より四肢麻痺を認め，救急車にて地元の病院へ搬送。第4頚椎脱臼骨折・頚髄損傷の診断（Fig. 9）。同日，同大学医学部付属病院に搬送。頚椎前方除圧固定術を行う。1997年3月，神奈川県立リハビリテーションセンターへ転院。1998年3月，第92回国家試験合格。現在大学医学部精神科にて研修中。右C5，左C4以下の麻痺ジョイスティックタイプの電導を加えたスティックにてコンピュータを操作している[2)]。

症例3[1)]：19歳，男性，N大学医学部2年生，身長175 cm，体重78 kg。

ポジション：右プロップ。

運動歴：中学高校時代，柔道。

ラグビー歴：1年3ヵ月。

経過：1998年7月29日，西日本医科大学大会ラ

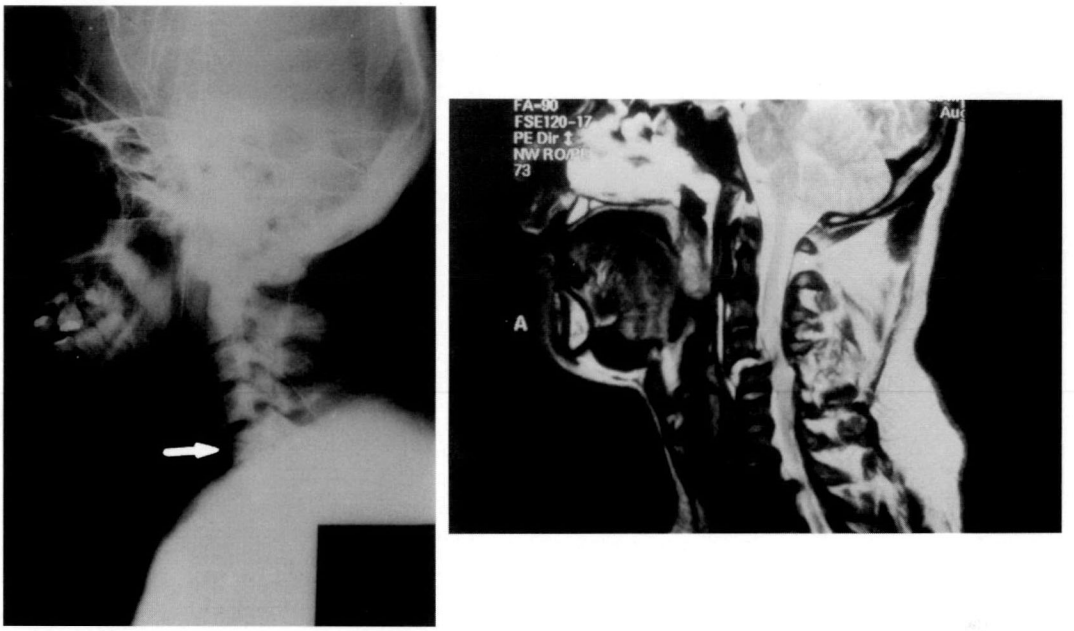
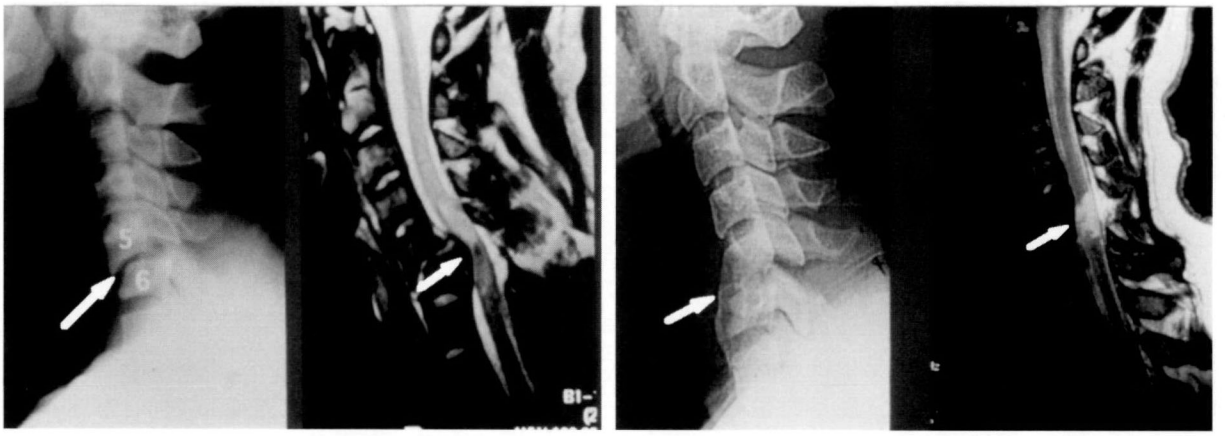


Fig. 9　症例2：受傷時頚椎X線像とMRI像
第4頚椎脱臼骨折，頚髄損傷を認める。



手術前　　手術後

Fig. 10　症例3：受傷時および術後のX線像とMRI像
第5頚椎前方脱臼骨折。

グビー部門出場のため，朝，フエリーで長崎より大阪へ到着。車で開催地，兵庫県神奈部高原に午後2時頃到着。午後4時より愛媛大学との合同練習を行う。午後4時30分頃よりスクラムの練習開始。スクラム(8対8)を組む際，タイミングが合わず頭部が相手の肩にあたり，胸元に入らず頚椎屈曲位で前後より力が加わった後スクラムが崩れ受傷。受傷直後より四肢麻痺を呈し，ただちに救急車で公立病院搬送。同日，公立病院にてC6椎体亜全摘C5～C7前方固定術施行(Fig. 10)。診断は，第5頚椎前方脱臼骨折，C6頚髄損傷。1998年8月25日，母校大学病院転送，リハビリテーション科へ入院。入院時，C6以下の麻痺を認めたが，その後やや回復を認める。体幹両下肢の機能全廃。膀胱直腸障害あり，補

助具を使っての食事，書字可能，自力で車椅子へ移動可能，パソコンの使用も可能。1999年9月からの復学を目指して国立別府重障者リハビリテーションセンターにてリハビリ中。

4. 考　察

1) 医学生ラグビー外傷の特徴

医学生のラグビー外傷の受傷部位は下肢に多く，下肢57例(30.3％)，次に頚部，顔面49例(26.1％)で，この2部位で外傷の約半数を占める。その他，肩甲体の外傷，上肢の外傷が多い。これは社会人や一般大学生のラグビー外傷と大差はない[3]。外傷の種類では骨折が多く，外傷全体の38.9％を占める。次いで靱帯損傷，脱臼，切挫創，捻挫と続いている。骨折で最も多いのは顔面骨折で，その主なものは鼻骨や頬骨の骨折が多い。なかには眼窩底骨折などの重症例もみられる。その他上肢の骨折では手指の骨折が多く，また下肢の骨折では足関節周辺の骨折が圧倒的に多い。これも一般のラグビー外傷と大差はない。靱帯損傷は膝関節に多く，なかでも内側側副靱帯損傷，前十字靱帯損傷が多く，やはり強い外力が加わるために起きた外傷である。脱臼では，とくに肩関節の脱臼および肩鎖関節の脱臼が多い傾向にあった。

受傷学年では1年生が多いと考えられていたが，本統計では3，4年生が多く，レギュラーとしてクラブで最も活躍している学年に外傷が多いものと思われる。ラグビー歴は，医学部学生は大学生からラグビーを始めた学生が多いため，受傷者も大学生からのラグビー経験者が大半を占めている。

ポジション別受傷者では，フォワードのプロップおよびNo.8，その他センターに受傷者が多い傾向にあった。スクラムの最前列のプロップに比較的外傷が多いことは，スクラムにおける受傷例が多いためと考えられる。受傷状況ではタックルによる受傷が多く(66％)，タックルをされた場合が多い。次にタックルをしての受傷が多かった。受傷状況では公式試合，練習試合等の試合中の外傷が最も多く，試合におけるコンタクトプレイが外傷につながるものと思われる。

考えられる受傷原因は医学生の特徴を示しており，最も多いのが練習不足で，学業で多忙なため練習は不足となる傾向がある。また体力差という点は，大学受験勉強に明け暮れ，大学に入って初めてラグビーを始め，まだ体力が十分でないうちにタックル，モールなどの激しいコンタクトプレイをすることが受傷原因の1つと考えられる。また，原因が未熟と答えた例が18.2％あり，体調不良が原因と並んでこれも医学生の特徴と考えられる。

2) 医学生のラグビー外傷の原因

外傷の原因のアンケートより，第1に練習不足があげられている。ラグビーというスポーツにおいて基礎体力の向上，技術の修得のため，また安全対策上十分な充実した練習は必須である。ラグビー競技にとって練習不足は外傷の最も重大な原因となりうる。とくに上肢，下肢，体幹の筋力強化トレーニングは外傷の予防に重要である。また外傷の原因の第2，第3に体力差，未熟という点が指摘されている。医学生は受験勉強に忙しく，またラグビーを初めて経験する選手が多い。ラグビーはコンタクトスポーツである故に，十分体力をつけ，技術をつけてから試合に出場させるべきである。とくに受傷原因の第1にあげられるタックルにおいてけがをしないために，基礎体力の増強，タックル技術の向上が重要である。

医学生ラグビー部員に対しての今回の調査では，重症外傷である脊椎の外傷発生は24例，内訳は頚椎が13例，胸，腰椎が9例で外傷全体の11.5％であった。受傷機転はスクラム，タックル時がほとんどであったが，その受傷原因として，脊椎外傷においても練習不足，体力差，技術の未熟をあげたものが多かったのが特徴的である。

重症の頚髄損傷は6例発生しており，3例がスクラム中，2例がラック時，1例がタックルの際受傷している。

及川ら[4,5]によれば頚髄損傷はスクラムの時に多く発生しやすく，ポジションとしてはプロップに多く発症し，スクラムでの予防が必要である。スクラムでも頚髄損傷の発生原因は①スクラムが崩れる時(collapsing)，②組む時の衝突(collision)，③組んだ状態で前3人が浮き上がるポッピング(popping)，のいずれかと考えられる。とくにフロントロー3人

にはフォワード8人対8人計16人の強力な外力が加わる。この力は約1.5 tにもなるといわれている。この状態でスクラムが崩れる場合，頚椎に強大な外力がはたらき，頚椎，頚髄損傷の起こる危険性がある。また，主にスクラムにおける外傷発生にはスクラムを組む技術や相手との個々の体力差，個々の身体能力や筋力，安全にスクラムを組むためのレフェリングなどの問題点も指摘されている。とくに医学生レベルでは，体力，筋力，技術がまだ十分でないため脊椎，脊髄損傷の発生率が高くなっている。

3）医学生ラグビー外傷の予防対策

(1) メディカルチェック

医学部学生は大学に入学してよりラグビーを始める学生が多いため，ラグビー入部時のメディカルチェックが必要である。メディカルチェックとして心電図，胸部X線撮影，血液生化学検査，頚椎X線撮影などが必要である。また，年に1度シーズンインの時，通常夏期合宿前に心電図，血液，生化学検査のチェックが必要である。チェックする項目として，阿部ら[6]によれば，頚部メディカルチェックとして，①頚部単純X線6方向にて頚椎側面像でのアライメント，脊柱管狭窄，椎間板変性，癒合椎の有無などをチェックする，②頚部MRIでは脊柱管狭窄，頚髄の脊柱管に対する占拠率，椎間板変性，椎間板後方膨隆，頚髄変性，頚髄空洞の有無など，③頚部筋力では屈曲筋力，伸展筋力，左右側屈筋力などが必要という。

(2) 医学部ラグビーの問題点と対策

現在の医学部ラグビーが抱える問題点をあげ，それら問題点に対し対策を講じる必要がある。問題点に関し高澤ら[2]は①部員の不足，②指導者の問題と啓蒙活動の必要性，③ラグビー大会運営の問題，の3点をあげている。部員数の不足に関して，スポーツ種目の増加やサッカーや野球人口の増加によるラグビー人口の減少や，各大学医学部における女子学生の割合の増加に伴い医学部ラグビー部員も減少傾向にある。そのために，肉体的・技術的に未熟な選手や外傷や障害が完治していない選手が無理をして試合に出場することがある。また中・高校生時代にほとんど本格的にスポーツに取り組んだことがないという学生が，基礎的な体力や技術を身につけることなく，部員が少ないからという理由で，他の選手と同じフィールドに立ってプレーをしなければならないという点がある。これは医学部ラグビーに重症外傷が多いことの一因と考えられる。また，このことは1年生に外傷が発生する理由でもある。

ラグビー指導者の点について，医学部においてはほとんどが医師であるOBが暇をみつけ，その指導を行うか，監督，コーチが存在せずに学生が主体となってタックルやスクラム等の基本技術の指導を行っている。このため，タックルやスクラムの基本的プレーに，基礎的な知識が十分でない点がある。安全講習会や技術講習会に選手のみならず指導者も積極的に参加させてゆくことが必要である。

(3) 大会の運営と事故予防対策

大会の運営に関して，東日本医科学生総合体育大会(東医体)におけるラグビー競技には約600人の医学生が参加しているが，問題点は菅平での開催と開催時期で，国家試験や卒業試験などの日程の都合上，1988年～1996年までは夏季(8月)に10日間で最高5試合という非常に過密なスケジュールのなかで開催されていた。試合中の救急車の手配が困難，診療所の設備が重症外傷に適していない，各チームともリザーブ選手の確保が困難である，試合日程が密で，とくに勝ち進んで行くと疲労回復しがたい，ルールの問題でスクラムなど技術，体力の未熟な選手には危険があるなどの点が委員会で指摘された。東医体は従来，医学生が中心となり運営することを1つの特徴として開催されてきたが，今回の事故をきっかけにその運営は改革され，予防対策に関し，①開催地の札幌への変更，②救急，救護体制の整備，旭川医大，札幌医大ラグビー部の協力，③ルールの変更，19歳以下(高校生)ルールの採用，④トーナメントの試合において試合間隔を1，2日あけるなどの対策がとられている。

一方，西日本医科学生総合体育大会(西医体)においても，大会は8月に兵庫県神奈部高原にて開催されており，ラグビーの外傷が最も多いことから，大会運営や開催時期について検討の必要性が提言されていた。1998年7月，西医体での頚髄損傷の発生に伴い事故究明委員会が設立され次のような決定がなされた。①スクラムでの高校生ルールの採用，②ヘッドキャップ着用の義務化，③試合はすべて25分

ハーフで行う，④1回戦と2回戦は1日あけ，それ以降は2日間あけて行う，⑤チームの現地入りは公式試合の前日とする，⑥試合前の練習試合，合同練習の禁止などである。

医学部ラグビー事故の予防対策は①試合の時期は夏の炎天下は避ける，②試合の場所は冷涼地とする，③試合方式としてなるべくトーナメントを避け，試合日程で間隔をあける，④学業との関連で，十分な練習が可能な時期で，試験直後は避ける，⑤ルールの改正として15歳未満のルールとする，⑥10人制の導入とともに，ラグビー未熟者の試合出場は慎重にするなどである。

日本ラグビーフットボール協会の統計[7]において，重症外傷の月別発生率は8月に最も高率であることが報告されており，気温27～32℃，相対湿度70％以上の時には練習を中止するか，練習時間・練習内容を変更し慎重に行うようにラグビーフットボール協会でも指導している。

今後の安全対策として①大会運営の再検討，②メディカルチェックの徹底，③安全，技術講習会の実施，④ルールの再検討，⑤10人制，12人制ラグビーの導入，⑥指導体制の検討などが重要である。

結　語

全国の医学部学生ラグビー外傷につき5年間のアンケート調査を行った。188例の外傷が集計された。受傷部位として肩関節脱臼や顔面，手指，鎖骨などの骨折が多く，61例(32.4％)が何らかの手術的治療を受けていた。受傷原因は練習不足，体力差，未熟などが特徴的であった。6例の頚髄損傷を含め，10例の重症外傷がみられた。ラグビー外傷の予防について検討した。

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A Comparison of the Clinical and Arthroscopic Parameters of Two Techniques for Anterior Cruciate Ligament Reconstruction Using Hamstring Tendons : The Outside-In Technique versus the Inside-Out Technique

膝屈筋腱を用いた前十字靱帯再建術：Outside-In法とInside-Out法の比較

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●Key words
Anterior cruciate ligament : Outside-In technique : Inside-Out technique
前十字靱帯，Outside-In法，Inside-Out法

●Abstract

This study presents the results from two different techniques of arthroscopically assisted anterior cruciate ligament reconstruction using hamstring tendons. The only differences in the surgical technique between the two groups were the fixing material used on the femoral side and the drilling method : the Outside-In technique (O-I) and the Inside-Out technique (I-O). Age, sex distribution and preoperative laxity were not significantly different between the treatment groups. Thirty-four patients underwent anterior cruciate ligament reconstruction. Seventeen patients underwent O-I, and 17 patients I-O. The clinical results in Lysholm score, final evaluation of IKDC form, and follow-up arthroscopic evaluation at one-year follow-up were compared.

Although both groups achieved similar satisfactory results in clinical outcome, some arthroscopic findings in both groups showed minor tears in the reconstructed ligament. We found mainly lateral fibers torn in the O-I group, and anterior fibers torn in the I-O group.

●要旨

今回われわれは膝屈筋腱を用いた前十字靱帯再建術において，Outside-In法とInside-Out

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法につき比較検討したので報告する。両群間の違いは，大腿骨側の骨孔の作成方法と固定材料の違いのみで，年齢，性別，術前の不安定性に有意差はなかった。Outside-In法17例，Inside-Out法17例，全34例である。約1年後の臨床成績をLysholm score，IKDCを用いて評価し，また再建靱帯の再鏡視像を評価した。両群とも臨床的にほぼ満足のいく結果が得られたが，再鏡視像において再建靱帯の軽度のほつれをとくにOutside-In法では外側線維，Inside-Out法では前方線維を中心に認めた。

Introduction

Good results from a number of techniques for anterior cruciate ligament reconstruction (ACL) using various materials have been reported[1~3]. Following the introduction of arthroscopic-assisted ACL reconstruction, two major surgical techniques have been developed to produce the femoral tunnel : the Outside-In technique (O-I) and the Inside-Out technique (I-O). The O-I technique requires two incisions ; an anteromedial incision for the tibial work and a lateral incision for the femoral metaphysis. The I-O technique requires only an anteromedial incision, and the femoral tunnel is drilled inside-out through the tibial tunnel.

We have been performing ACL reconstruction using the iliotibial tract (ITT), since 1979[4]. Here we report a comparison of the short-term clinical results and the follow-up arthroscopic evaluation of the two techniques used for ACL reconstruction : the Outside-In technique (O-I) and the Inside-Out technique (I-O).

Materials and Methods

Thirty-four patients with ACL injury participated in this study, undergoing reconstructive surgery using the hamstring tendons, between April 1997 and March 1999. The inclusion criteria for this study were : 1) unilateral ACL injury with normal contralateral knee, 2) closed physis and age younger than 45 years, and 3) no combined posterior cruciate ligament injury. Seventeen patients underwent the O-I technique (O-I Group), and the other 17 underwent the I-O technique (I-O Group). The O-I Group consisted of 10 males and 7 females, and the I-O Group of 11 males and 6 females. The mean age at surgery was 23 years (range : 16-31 years) in the O-I Group, and 25 years (range : 16-44 years) in the I-O Group.

Associated surgery in the O-I Group was medial meniscectomy in 4 patients, lateral meniscectomy in 4 patients, both medial and lateral meniscectomy in 2, medial meniscal repair in 3, and medial meniscal repair and lateral meniscectomy in 2 patients. In the I-O Group, 6 patients received medial meniscectomy, 3 lateral meniscectomy, 2 patients received both medial and lateral meniscectomy, and one patient underwent medial meniscal repair.

1. Surgical technique

The only differences in the surgical technique between the 2 groups were the fixing material used on the femoral side and the drilling method. According to the O-I technique, a hole measuring 8 ~ 10 mm in diameter was drilled as in the case of the modified over-the-top method, from the posterosuperior region of the lateroepicondyle of the femur to the posterior of the intercondyle in the joint, and fixed with a Fixation-Button, while a femoral hole was prepared around 11 o'clock of the intercondylar space in the case of a right knee from inside the joint and fixed with an Endobutton in the I-O technique (Acufex Microsurgical, Mansfield, MA)[6].

The O-I technique requires two incisions : an anteromedial incision for the tibial work and a lateral incision for the femoral metaphysis. The I-O tech-

nique requires only one anteromedial incision, and the femoral tunnel is drilled inside-out through the tibial tunnel.

In addition, the tibial hole was prepared in the posterior of the extended Brumensaat's line, in a totally extended position and fixed with a Fixation-Button. Notch plasty was perfomed during the operation, if necessary.

2. Rehabilitation protocol

Patients in both groups followed the same early rehabilitation protocol. Range of motion exercise using a continuous passive motion device was started immediately after surgery, and weight-bearing was initiated within the first week. Jogging was allowed three to four months after surgery, and sports activities were allowed at more than six months after surgery, depending on the condition of the knee in each patient. The postoperative treatment was aimed at early complete extension and flexion, and no brace was used.

3. Clinical evaluation

We evaluated the one-year follow-up results in this study using the Lysholm score and the assessment according to the International Knee Documentation Committee (IKDC Knee Ligament Standard Evaluation Form).

4. Follow-up arthroscopic evaluation

Arthroscopic findings of the reconstructed ligaments at 1 year after the operation were used as the means of assessment.

As to the arthroscopy findings, 3 items including the thickness, tension and capsulation of the synovial membrane were assessed in 4 grades (Fig. 1). The case shown in Fig. 1a was assessed as excellent. Due to some fraying in the anterior fibers, the case in Fig. 1b was assessed as good. The case in Fig. 1c was judged as fair, because of a partial tear in the anterior fibers on the femoral side. As there was no capsulation of the synovial membrane and no tension, the case in Fig. 1d was assessed as poor.

5. Statistical analysis

Statistical analysis was performed using the Mann-Whitney' U test and chi-square test for independence.

Results

1. Diameter of the graft

The mean diameters of the grafts measured during surgery were 8.3 mm (range : 8-10 mm) in the O-I Group, and 8.7 mm (range : 8-10 mm) in the I-O Group. There was no significant difference between the two groups.

2. Range of motion

Three patients in each group showed an extension deficit of 3-5°. In each group, only one patient showed a flexion deficit of 10°. There was no significant difference between the two groups.

3. Anterior Knee Laxity Measurements using the KT1000

Anterior translation as measured by KT-1000 (MedMetrics, San Diego, CA) was graded A in 11 patients and B in 6 patients in the O-I Group, and A in 11 patients, B in 5 patients, and C in 1 patient in the I-O Group. No patient was graded D.

The mean side-to-side difference was 1.7 ± 1.5 mm in the O-I Group, and 2.0 ± 4.4 mm in the I-O Group (Table 1), with no significant difference.

4. Lysholm score

The mean Lysholm score was 95.1 (range : 65-100) in the O-I Group, and 94.9 (range : 86-100) in the I-O Group (Table 1). The difference was not statistically significant.

5. IKDC evaluation form

The lowest grade of the four evaluation parameters (patient subjective assessment, symptoms, range of

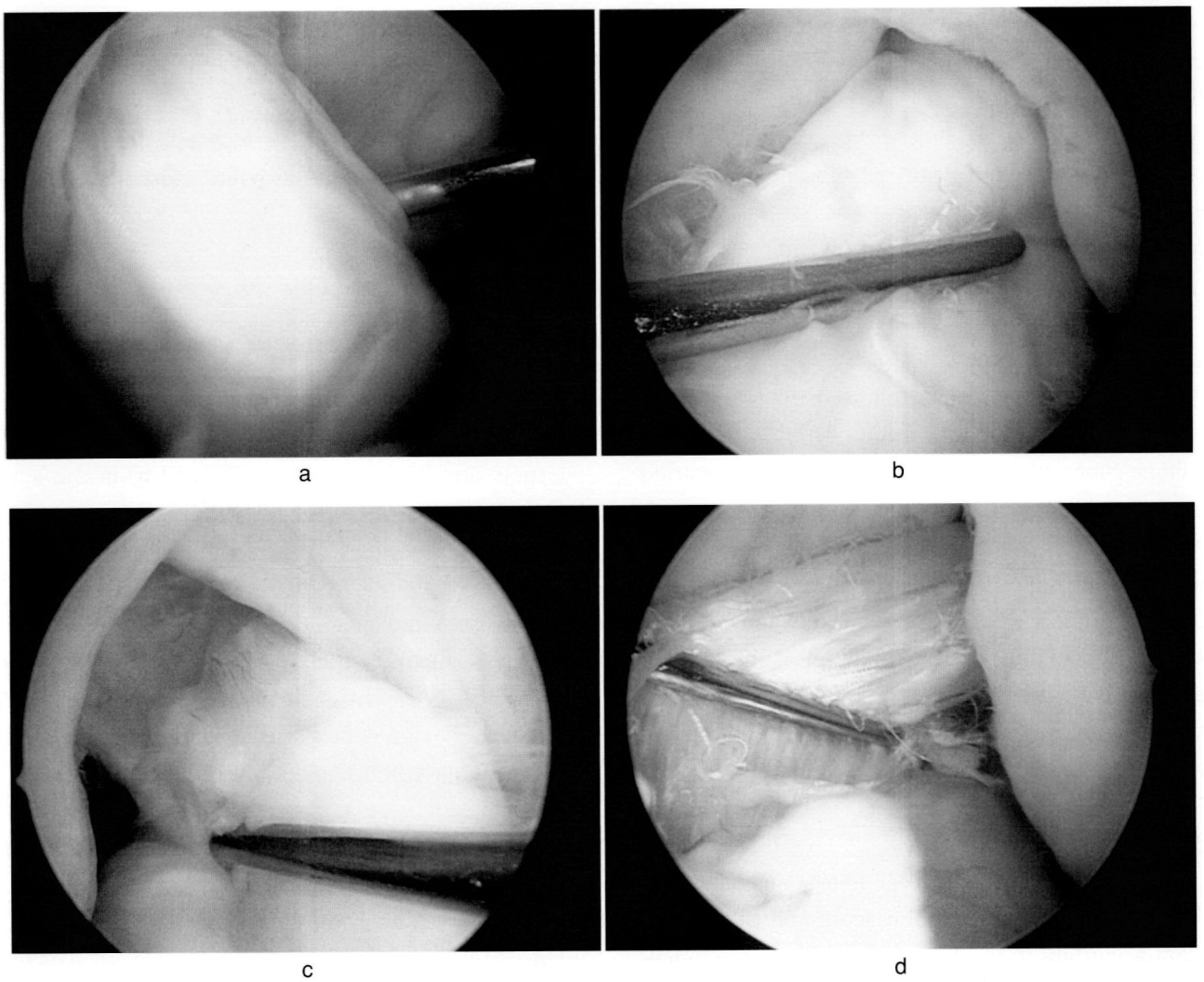

Fig. 1 Arthroscopic findings.
a : Excellent, b : Good, c : Fair, d : Poor.

motion, and ligament examination) was used as the final assessment value.

Two patients were graded A, 13 as B, and 2 as C in the O-I Group, and 3 as A, 11 as B, and 3 as C in the I-O Group (Table 1). There was no significant difference between the two groups.

6. Arthroscopic findings

Arthroscopic findings did not indicate any significant differences between the groups (Table 2). However, some differences in slight fraying and minor tears in the ligament were observed. A few of those using in the O-I Group demonstrated fraying in various manners such as mostly in the anterior in 2 cases, and laterally in 2 other cases (Fig. 2). However, fraying and small tears were mainly observed in the anterior in the I-O Group (anterior in 4 cases and all over in 1 case) (Fig. 3) (Table 3).

Discussion

There have been various studies comparing the O-I and I-O techniques in ACL reconstruction, with many of them reporting that the outcomes were all

Table 1

	Outside-In Technique	Inside-Out Technique	
Diameter of the graft	8.3 mm	8.7 mm	
K-T2000			
A(-1~2mm)	11	11	
B(3~5, -1~-3mm)	6	5	
C(6~10, <-3mm)	0	1	
D(10mm<)	0	0	
Mean side-to-side diference	1.7mm	2.0mm	N.S
Lysholm Knee Scoring scale	95.1	94.9	
IKDC Final Evaluation			
A	2	3	
B	13	11	
C	2	3	
D	0	0	N.S

Table 2 Arthroscopic evaluation

	Outside-In Technique	Inside-Out Technique
Excellent	8	6
Good	6	7
Fair	3	2
Poor	0	1

N.S.

Table 3 Slight fraying and minor tears

	Outside-In Technique	Inside-Out Technique	
Mainly anterior fibers	2	4	
Mainly lateral fibers	2	0	
All over	0	1	N.S.

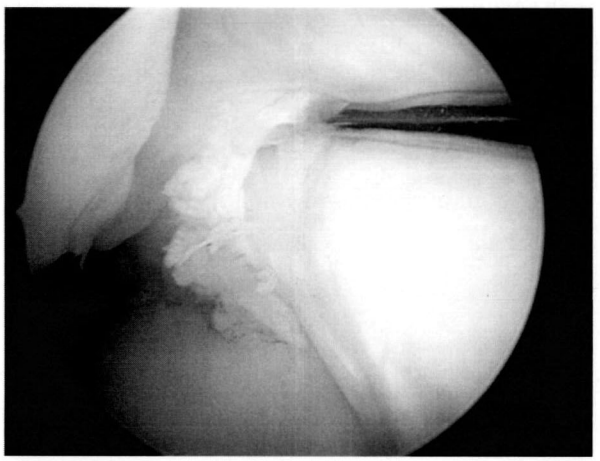

Fig. 2 Outside-In technique.

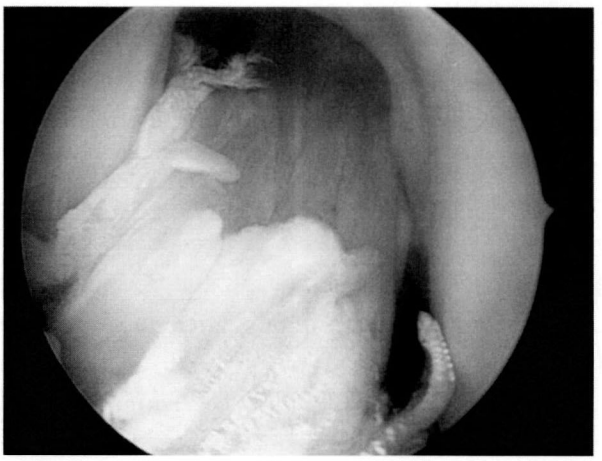

Fig. 3 Inside-Out technique.

favorable and that there was almost no significant difference in the clinical results and knee stability between them[7~9].

Similar results were obtained in the present study as well. There was no statistical significance between the two groups in the KT difference between the affected and normal sides, in Lysholm knee scoring scale, and in IKDC. However, satisfactory results were not obtained in all the cases. Arthroscopy occasionally indicated a slight fraying in the ligament. In some cases, the arthroscopy assessment and clinical results were not necessarily correlated[10, 11], and this

has been considered to be a factor for poor prognosis.

The mechanical stresses imposed on the reconstructed ligament include notch impingement in the intercondyle[12], windshield wiper motion in the aperture of the drilled hole, and length change[13, 14] in the entire ligament. Of these stresses, windshield wiper motion and length change have demonstrated different patterns between the groups.

Notch impingement could be prevented to some extent because it was possible to check the status under the arthroscope and perform notch plasty during the operation, if necessary. However, arthroscopy findings such as re-growth and the intercondyle pressurized by a so-called Cyclops lesion[15] and osteophytes are sometimes observed after the operation. These stresses are loaded on the lateral fibers of the reconstructed ligament in the case of wall impingement, and mainly on the anterior fibers in the case of roof impingement. However, notch plasty was not performed in the follow-up arthroscopy in any of the cases in the present study.

The stress on the aperture of the femoral hole which demonstrated a difference between the groups is considered to be concentrated on the flexing site when the knee is bent until the reconstructed ligament and the hole are firmly fixed. The stress is expected to be imposed in the lateral fibers of the ligament in those operated on using the O-I technique and in the anterior fibers in those who underwent the I-O technique.

Attention should be paid to the isometric point according to many reports made on this subject. A reverse over-the-top pattern is formed when the hole is prepared somewhat forward of the isometric point in the femoral side, and this may cause stress in the ligament in the flexed position when the ligament is fixed in the extended position. It is also difficult to achieve complete isometry over all the fibers in the case of reconstruction of a wide ligament. Especially, the I-O technique has the risk of the femoral hole being drilled in the anterior so as not to damage the posterior wall. This may increase the stress in the anterior fibers. Based on the above, the site in the ligament subject to mechanical stress was compared between the two surgical techniques. In the O-I technique, the stress in the ligament fibers is dispersed. However, in the I-O technique, there is a possibility that the stresses of notch impingement on the intercondyle, windshield wiper motion in the aperture of the femoral hole and length change are centralized in the anterior fibers.

Conclusion

1. The postoperative arthroscopy findings were compared between the O-I technique and the I-O technique in patients who underwent ACL reconstruction by multiple folding of knee flexor tendons.
2. Although the observation period was rather short, there was no significant difference in the clinical results and postoperative arthroscopy findings between the two methods.
3. Fraying mainly in the anterior fibers was observed, in those operated using the I-O technique.
4. It is considered likely that the stresses are concentrated in the anterior fibers, in those operated using the I-O technique.

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Anterior Cruciate Ligament Reconstruction Using Multiplied Hamstring Tendons : The Effects of Bone Tunnel Length —Compared between the Outside-In Technique and the Endobutton Technique

膝屈筋腱を用いた前十字靱帯再建術の術後成績：骨孔長の異なるOutside-In法とEndobutton法の比較

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●Key words
ACL reconstruction : Hamstring tendon : Tunnel length
前十字靱帯再建術，膝屈筋腱，骨孔長

●Abstract

In order to investigate the effect of the femoral bone tunnel length, two groups were chosen from our ACL reconstruction series. In Group 1, the femoral bone tunnel was produced using the Outside-In (OI) technique and a skin incision (n = 15). In Group 2, the femoral bone tunnel was made using the Inside-Out technique and femoral fixation was performed using the Endobutton technique (EB ; n = 38). The Lysholm score, IKDC score, and side-to-side difference in anterior laxity measured using a KT-2000, demonstrated no significant difference between the two groups. The femoral bone tunnel length of Group 1-OI (27.9 ± 3.4mm) was significantly shorter than the length of Group 2-EB (48.2 ± 7.7mm ; $p < 0.05$). In summary, the femoral tunnel length was significantly longer in the Group 2-EB, and at 1 year after surgery, no significant difference was demonstrated in Lysholm score, IKDC score or in anterior laxity measured using a KT-2000 between two groups.

●要旨

ACL再建術においては移植腱の初期固定間距離が長いと，微細な動きが生じ，生物学的固

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定に影響を与えると推測されている。本研究では，自家屈筋腱を用いたACL再建術の大腿骨孔の長さと臨床成績について検討した。大腿外側に皮切を加え，骨孔をoutside-inに作成し，移植腱をポストスクリューで固定したOI群15例と，大腿骨孔を関節内より作成し，Endobuttonで固定したEB群38例を対象とした。大腿骨孔の長さは，OI群で27.9±3.4 mm，EB群で48.2±7.7 mmと有意差を認めたが，Lysholmスコア，IKDCスコア，KT-2000前方移動量については有意差を認めなかった。

Introduction

Introduction of the Endobutton (Smith & Nephew Endoscopy, Andover, MA, USA) has produced an easy and fast fixation method in anterior cruciate ligament (ACL) reconstruction. In this method, the femoral-sided Endobutton and a tibial-sided screw or staple is used to achieve the hamstring tendon graft fixation. The amount of graft motion within the bone tunnels, and the effects of cyclic loading on the graft are important variables for biological fixation of the graft[1]. Longitudinal graft tunnel motion (bungee effect) describes motion of the graft along the axis of the bone tunnel. Graft motion can also occur in the sagittal plane when the graft moves anteriorly and posteriorly within the bone tunnel (windshield wiper effect).

Hamstring grafts are utilized with tapes or strings which have various biomechanical properties, and these two effects can easily occur when the total graft length is long. The total graft length depends upon several factors, one of which is bone tunnel length. In the present study, in order to investigate the effect of the femoral bone tunnel length, two groups were chosen from our ACL reconstruction series. The purposes of this study were to compare two different ACL reconstruction techniques and to investigate any clinical differences in regard to the femoral bone tunnel length.

Materials and Methods

A retrospective study of all patients undergoing ACL reconstruction with multiplied hamstring tendon autografts in our institute was undertaken. During the 36-month period between February 1997 and August 1998, 53 consecutive patients underwent primary ACL reconstruction using hamstring tendons. In this study, cases with reconstruction using the iliotibial tract, bone-patella tendon-bone and cases requiring multiple ligament reconstructions were eliminated. The 53 patients in this study were then divided into two groups according to their surgical treatment.

Group 1-OI consisted of 15 patients (5 male, 10 female, average age 19.3 years) who underwent ACL reconstruction using the Outside-In (OI) femoral bone tunnel technique and a skin incision. The harvested semitendinosus tendon was folded three or four times, and if necessary, the doubled gracilis tendon was added. The graft was connected with non-absorbable strings (No.2 Ethibond ; Ethicon, Somerville, NJ, USA) at both ends and passed through the lateral femoral condyle into the proximal tibia through the knee joint, then fixed with post-screws in both femoral and tibial sides (Fig. 1).

Group 2-EB consisted of 38 patients (21 male, 17 female, average age 22.4 years) who underwent ACL reconstruction using the Endobutton (EB) technique, consisting of femoral bone tunnel and femoral end graft fixation. Merciline tape (Ethicon, Somerville, NJ, USA) or Endobutton tape (Smith & Nephew Endoscopy, Andover, MA, USA) was used to connect the Endobutton and the graft consisting of the folded semitendinosus (and gracilis) tendon(s). The tibial side was connected with non-absorbable strings (No.2 Ethibond) and fixed using a post-

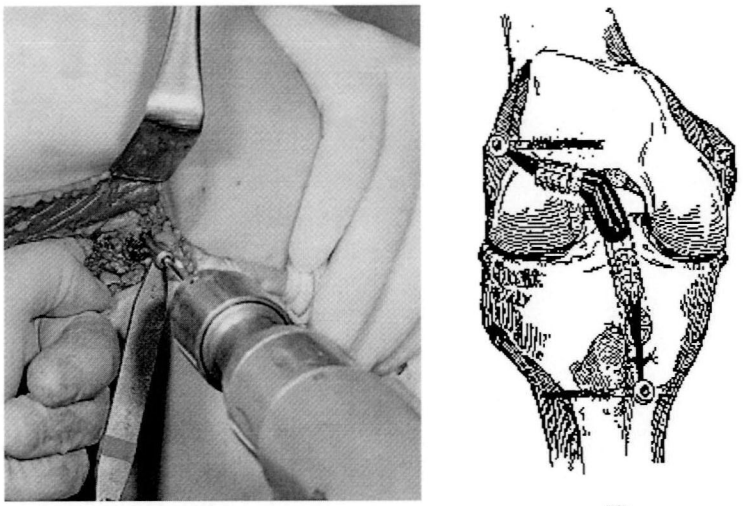

Fig. 1 Group 1-OI. The femoral bone tunnel was produced using the Outside-In technique and a skin incision (A). The graft was fixed with post-screws in both the femoral and the tibial sides (B).

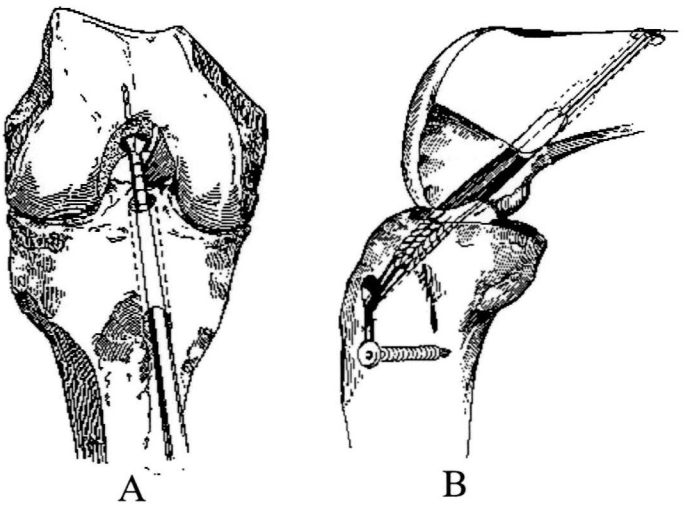

Fig. 2 Group 2-EB. The femoral bone tunnel was made using the Inside-Out technique (A), and femoral fixation was performed using the Endobutton technique (B).

screw (Fig. 2).

All patients had reconstruction performed by two surgeons (M.S., A.T.). Similar indications were followed, with all patients presenting symptomatic instability and objective patholaxity as defined by manual ligament and instrumented arthrometer (KT-2000 ; MEDmetric, San Diego, CA, USA) testing, and patients were divided into two groups randomly. At one year after reconstruction, assessment of the two groups was performed by Lysholm[2] and IKDC (International Knee Documentation Committee)[3] scores. Further anterior posterior laxities measured

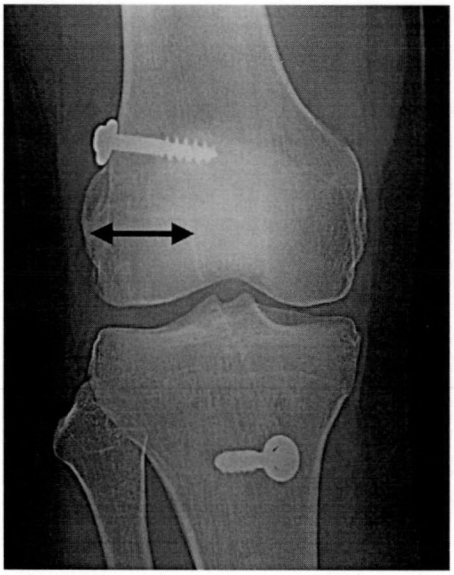

Fig. 3 The femoral bone tunnel length of Group 1-OI was measured from a radiograph at 1 year post-surgery (arrow).

by KT-2000 and femoral bone tunnel length were evaluated. The femoral bone tunnel length of Group 1-OI was measured from a radiograph at 1 year post-surgery (Fig. 3), and the tunnel length of Group 2-EB was measured intra-operatively. Statistical analysis was performed with ANOVA (analysis of variance), and a level of significance at $p = 0.05$ was applied to compare the two groups.

Results

The Lysholm score (mean ± S.D.) was 97.6 ± 3.8 in Group 1-OI, and 97.4 ± 3.3 in Group 2-EB, with no significant difference. Table 1 shows the final evaluation of each group based upon the IKDC scoring scale. Overall, good to excellent results were noted in 88 % of Group 1-OI patients and in 90 % of Group 2-EB patients, with no significant difference. The side-to-side difference in anterior laxity (mean ± S.D.) measured using the KT-2000 was 1.8 ± 2.1 mm in Group 1-OI, and 2.2 ± 1.7 mm in Group 2-EB, with no significant difference.

Table 1 IKDC final evaluation

IKDC Group Grade	Group 1-OI N=15	Group 2-EB N=38
A (Excellent)	8 (53%)	12 (32%)
B (Good)	5 (33%)	22 (58%)
C (Fair)	2 (12%)	4 (10%)
D (Poor)	0	0

The femoral bone tunnel length (mean ± S.D.) of Group 1-OI measured on a radiograph was 27.9 ± 3.4 mm, and of Group 2-EB measured intra-operatively was 48.2 ± 7.7 mm. The femoral bone tunnel length of Group 1-OI was significantly shorter than the tunnel length of Group 2-EB ($p < 0.05$).

Discussion

In Group 1-OI, the femoral bone tunnel was created by the Outside-In technique with a modified over-the-top route[4, 5]. In this technique, the femoral tunnel is located on the coronal plane of the femur, and the length is measurable on a radiograph A-P view. In contrast, the femoral bone tunnel length of Group 2-EB was measured intra-operatively. Although the method of measurement differed between two groups, the tunnel length of Group 2-EB was significantly longer than that of Group 1-OI ($p < 0.05$).

The magnitude of graft tunnel motion (bungee effect, windshield wiper effect) can theoretically be increased by fixation of the graft distant from the joint line or osseous tunnel entrance. In a biomechanical study, graft fixation distant from the joint line resulted in significantly more anterior laxity than did graft fixation near to the joint line[6]. Graft tunnel fixation, such as tendon bone healing, progressed from random collagen fiber to longitudinal orientation (Sharpey's fibers) over the initial 12 weeks. A uniform sinusoidal crimp pattern similar to that seen in normal ACL was observed, and graft tunnel fixation was mostly completed, by 24 weeks[7, 8]. In the

present study, the same operative technique as tibial bone tunnel and tibial fixation, same graft material property and the same protocol of rehabilitation were employed in both groups. The femoral tunnel length was significantly longer in Group 2-EB, and at 1 year after surgery no significant difference was demonstrated in Lysholm score, IKDC score or in anterior laxity measured using the KT-2000, between the two groups. In conclusion, the femoral bone tunnel length did not influence clinical results including Lysholm score, IKDC score and anterior laxity. However, a longer term follow-up and precise comparison are needed to reveal the significance of these findings.

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Posterior Cruciate Ligament Injury and Return to Sports Activities

膝関節後十字靱帯損傷とスポーツ復帰について

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● Key words
Knee joint : Posterior cruciate ligament : Reconstruction
膝関節，後十字靱帯，再建術

● Abstract

The reasons why sports activities were not severely affected by posterior cruciate ligament (PCL) injury, were analyzed based on our original data and a review of the literature. The first reason was that subjective instability was not severe in PCL injury, and this may be attributable to 1) the posterior inclination of the tibial plateau, by which the posterior instability is constrained by the axial load itself ; 2) the smaller magnitude of posterior instability in extension ; and 3) the presence of a substantial remnant. The second reason was that secondary changes in the menisci and articular cartilage were relatively mild. The third was that the patients with a PCL injury were fundamentally less active, and thus their rate of return to their original level of sports activity was calculated as high. For these reasons, their activities were not severely affected, and this has been the main reason for PCL injury usually being treated conservatively.

● 要旨

後十字靱帯(PCL)損傷はスポーツ復帰率がよいとされているが，その理由をわれわれのデータと過去の文献に基づいて分析する。第1の理由は自覚的な不安定感が小さいことである。これは①脛骨の後傾角により荷重そのものが後方不安定性を制御すること，②後方不安定性が伸展位で小さいこと，③PCL損傷では遺残組織が残りやすいことが関与している。第2の理由は2次的な半月板や関節軟骨の損傷が少ないことである。第3の理由はPCL損傷患者では元々活動レベルが低く，計算上のスポーツ復帰率が高くなることである。以上の理由から，PCL損傷では活動レベルがあまり下がらず，これが保存療法が主に選択されてきた理由になっている。

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Introduction

Knee ligament injury often impedes the sports activities of athletic people. Anterior cruciate ligament (ACL) injury, in particular, sometimes ends their sports life[1~3]. In contrast, it has been reported that sports activities were not severely affected by a posterior cruciate ligament (PCL) injury[4, 5], and several reasons have been cited for this : 1) subjective instability in PCL injury was not as severe as in ACL injury[4, 5] ; 2) secondary changes in the menisci and articular cartilage were relatively mild compared with ACL injury[6] ; and 3) PCL-injury patients were fundamentally less active than ACL-injury patients, since most PCL injuries were caused by a traffic accident rather than by sports[7]. In this paper, each of these explanations was analyzed based on our original data and the existing literature, and the policy of PCL treatment is discussed.

Subjective Instability in PCL Injury

The PCL is a strong ligament. Its tensile strength is approximately twice that of the ACL[8], and it is the primary restraint of posterior instability in the knee joint. Thus, substantial posterior instability occurs, when it is injured. Suda reported that the increase in anterior-posterior directional instability in PCL injury was between 2.4 and 10.1 mm, depending on the flexion angle examined[9]. However, it has been reported that PCL injury patients usually complained of less subjective instability, than ACL injury patients. Shino et al reported that 14 of 15 patients who were treated conservatively remained athletically active[4]. Torg et al stated that solitary PCL injury patients will remain symptom-free[5]. Thus, in the literature it is recognized that the subjective instability in the PCL injury was not as severe as in ACL injury, even though the objective instability was usually severer.

One of the reasons for this lies in the posterior inclination of the tibial plateau. Higgins reported that the tibial plateau was posteriorly inclined at an average of about 7°, based on a cadaveric study[10]. Because of this posterior inclination, an axial load placed on the tibia by weight bearing at relatively extended positions produces an elemental force in the anterior direction (Fig. 1). The tibia may displace anteriorly because of this anterior elemental force if the ACL is torn, but the joint is somewhat stabilized by weight bearing in a PCL-injured knee. This may be one of the reasons for the subjective instability of a PCL injury not being as severe in daily life or sports activities as the subjective instability of an ACL injury.

Another possible reason is that the magnitude of posterior instability due to PCL injury is severer in flexion and milder in extension. Our original data from a cadaveric study showed that the magnitude of posterior translation after sectioning of the PCL was 10.1 mm at 90° of flexion, 9.0 mm at 60°, 6.9 mm at 30°, 5.0 mm at 15°, and 2.4 mm in full extension[9] (Fig. 2). Similar results were obtained in other studies, both *in vivo* and *in vitro*[11, 12]. Therefore, even if a substantial posterior drawer sign is observed at 90° of flexion, sports activities are not seriously affected, as the knee is usually used in a flexion range below

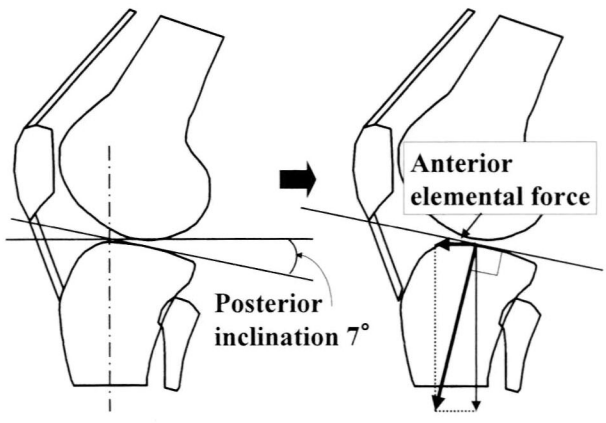

Fig. 1 Posterior inclination in the tibial plateau. Because of this posterior inclination, the axial load placed on the tibia by weight bearing at relatively extended positions produced an elemental force in the anterior direction.

60° in ordinary sports activities.

In addition, a substantial remnant usually remains after PCL injury, which means that a firm end-point remains[13]. This may be another reason for the subjective instability not being as severe as in ACL injury. Our quantitative data obtained using a KT-2000 knee arthrometer showed a significant decrease in the anterior terminal stiffness, representing an anterior end-point, in the ACL-injured knee, but no significant change in the posterior terminal stiffness in the PCL-injured knees[13] (Fig. 3). This was consistent with the experience of Jacob who stated, "We have repeatedly observed that, despite an increased posterior translation of 10 mm, the posterior end point at 80° of flexion was still firm"[14]. However, it is also true that the pathology of PCL injury is not uniform, and that there are some PCL-injured knees in which the posterior terminal stiffness is substantially reduced[15] (Fig. 4).

Secondary Changes in the Menisci and Articular Cartilage

The second factor is that the secondary changes in the menisci and articular cartilage are relatively mild in PCL injury, and these are the major factors in ACL injury patients not returning to their original level of sports activities[16].

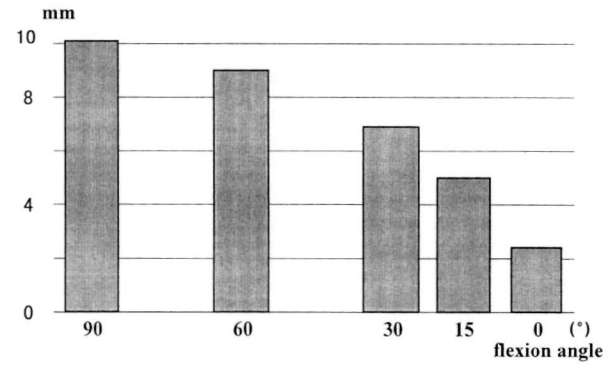

Fig. 2 Magnitude of posterior translation under a 147N posteriorly directed force after sectioning of the PCL.
The magnitude of the posterior translation is severer in flexion and milder in extension.

Our data showed that meniscal injuries combined with PCL injury occurred in 17 % of patients within one year after the injury, 20 % between one and two years, and in 16 % at more than two years[6]. These figures were much lower than those after ACL injury

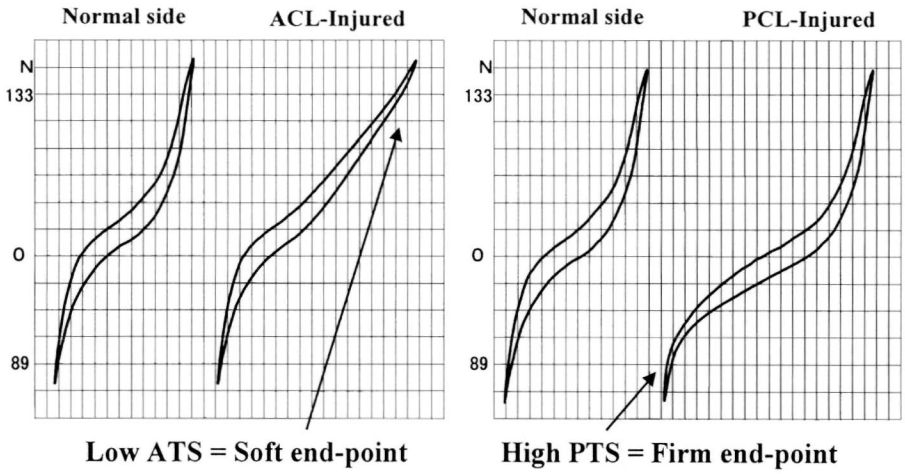

Fig. 3 Typical force-displacement curves obtained using a KT-2000 knee arthrometer.
A decrease in anterior terminal stiffness (ATS) was often observed in the ACL injured knees, but no significant change in posterior terminal stiffness (PTS) in the PCL injured knees.

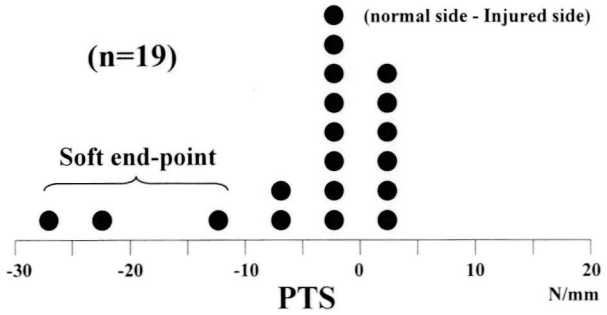

Fig. 4 Distribution of the posterior terminal stiffness (PTS) in PCL-injured knees.
There were some PCL-injured knees in which the posterior terminal stiffness was substantially reduced.

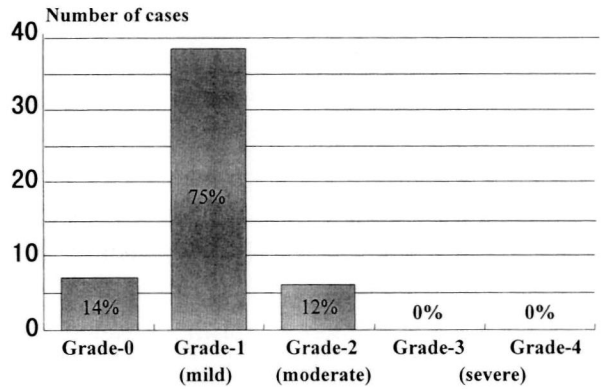

Fig. 6 Incidence of secondary osteoarthritic changes.
At one year after the injury, moderate changes were observed in only 12% of the PCL injured patients, and no severe change was observed in any of them.

(Fig. 5). At one year after the injury, moderate osteoarthritic changes were observed in only 12% of the PCL-injury patients, and no severe changes were observed in any of them[6] (Fig. 6). One of the reasons for this low incidence of secondary changes after PCL injury may also lie in the posterior inclination of the tibial plateau. This posterior inclination stabilizes the posterior instability when the axial load is applied to the joint, as described before, and no large shearing force is applied to the menisci and articular cartilage. Another reason for the low incidence of secondary changes is that PCL injury patients are less active than ACL injury patients, as described in the next section.

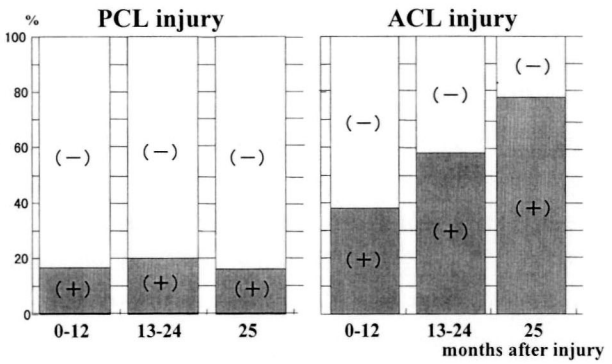

Fig. 5 Incidence of combined meniscal injuries.
The incidence of combined meniscal injuries in PCL injury was much lower than in ACL injury.

Activity Level of PCL Injury Patients

PCL injury patients are fundamentally less active than ACL injury patients, which is one of the reasons for the high return rate to their original sports level. We reviewed 86 patients who underwent a PCL reconstruction in our institutes, and analyzed their activity levels and causes of injury. They consisted of 75 males and 11 females, with an average age of 26. Our data showed that 60% (involving 52 of 86 patients) of the PCL injuries were caused by a traffic accident, and that most of these (40 of the 52 patients : 77%) were due to a motorcycle accident, which is in contrast to the fact that more than 90% of ACL injuries were caused by sports (Fig. 7). In addition, active athletes (who regularly engage in sports three times a week or more) represented only 15% of the PCL injury patients, as opposed to 75% of the ACL injury patients (Fig. 8). Thus, the fact that the original activity level of PCL-injury patients was fundamentally low is one of the reasons why the rate of return to their original level of sports activities was high.

Discussion

According to the various factors, described above, all of which have a mutual affect on each other, many PCL-injury patients can return to their original level of sports activities. Therefore, PCL reconstructive surgery is not required in most PCL-injury cases, even if gross objective instability persists. This high rate of return to their pre-injury level seems to be the main reason that PCL injury is usually treated conservatively.

However, it is also true that there are quite a few patients who are athletically active and complain of subjective posterior instability during sports depending on the sports activities and events. In addition, the pathology of the instability is not the same in every case, and there are some PCL injured knees in which a relatively soft posterior end-point is observed, as described above. Therefore, it is important not to treat PCL injury uniformly, but by taking into consideration the specific pathology and activity in each case.

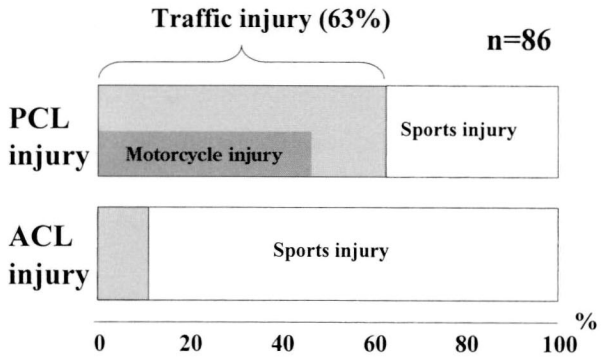

Fig. 7 Initial causes of PCL injury and ACL injury.
60% of the PCL injuries were caused by a traffic accident and most of them (77%) were due to a motorcycle accident, which is in contrast to the fact that more than 90% of the ACL injuries were caused by sports injury.

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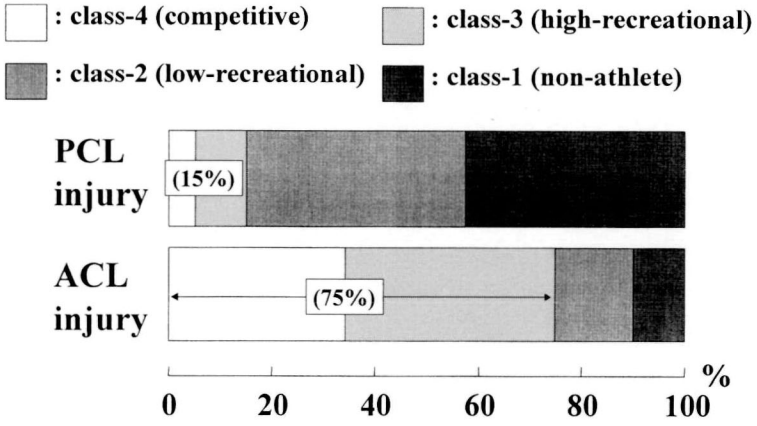

Fig. 8 Activity levels of PCL-injury patients and the ACL-injury patients.
Active class-3 or class-4 athletes comprised only 15% of the PCL injury patients, as opposed to 75% of the ACL injury patients.

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第5回日韓整形外科スポーツ医学会発表論文

Reconstruction of Posterolateral Rotatory Instability in the Elbow : A Case Report

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● Key words
Elbow : Posterolateral rotatory instability : Pivot shift test : Reconstruction

● Abstract

Recurrent posterolateral rotatory instability in the elbow has been described recently as a clinical entity. It follows injury to the lateral ulnar collateral ligament. Posterolateral rotatory instability is the most common pattern of elbow instability especially that which is recurrent, and is usually post-traumatic and caused by inadequate soft tissue healing. A 22-year-old male soldier, fell on his outstretched hand and injured his right (dominant) elbow. A pivot shift test was done under anesthesia, with the patient in the supine position and the affected arm overhead, holding the wrist and forearm starting from the extended elbow to slight flexion while applying valgus axial compression and supination momentum. The lateral ulnar collateral ligament was reconstructed using the palmaris longus tendon. Creating a hole for the suture anchor system (MITEK G-II, Linvatec, USA) one proximally at the anatomic site of attachment (isometric point in the lateral epicondyle) and another distally near the supinator crest of the ulnar, a tendon graft was fixed. At 4 months after the operation, a functionally good result was obtained. This is a case report illustrating the clinical features and anatomic study of posterolateral rotatory instability in the elbow and its reconstruction using the palmaris longus.

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Introduction

Recurrent posterolateral rotatory instability in the elbow is rare and has been described recently as a clinical entity by O'Driscoll et al[1]. It is known to result from an injury to the lateral ulnar collateral ligament following trauma such as subluxation, dislocation or fracture, repeated overloading in the cubitus varus deformity, and as sequella from tennis elbow operation. This ligament laxity leads to rotatory subluxation in the ulnohumeral joint, and is confirmed by kinematic study[2].

In many patients with a recurrent posterolateral rotatory instability, clinical subluxation does not occur. However in some patients, it may appear to be distinct with provocative maneuver. This is a case report illustrating posterolateral rotatory instability, its provocative test —the pivot shift test proposed by O'Driscoll— and its reconstruction using the palmaris longus tendon.

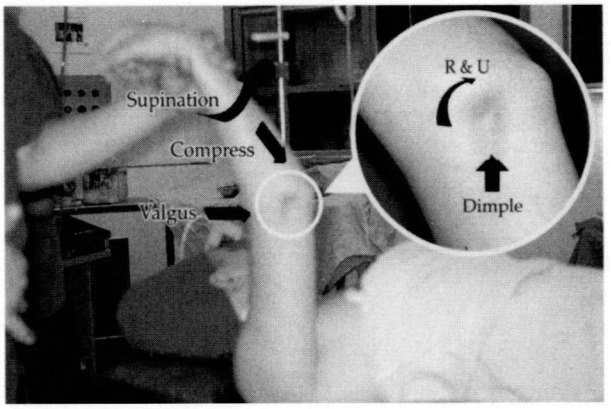

Fig. 1 The positive pivot shift test of the elbow.
Holding the wrist and keeping the forearm fully supinated starting from the extended elbow to slight flexion while applying valgus axial compression and supination momentum. This created a semi lunar notch in the ulnar separated with radius from the humerus posterolaterally. Subluxated radial head and ulnar (R & U) with typical skin dimple proximal to the radial head (circle in the right).

Case Report

A 22-year-old male soldier fell on his outstretched hand in 1995 and injured his right (dominant) elbow. His elbow became swollen painfully. He was treated by a general physician at first, and his elbow was not immobilized. Having been subluxated 4 times between 1995 and 1999, he felt serious apprehension and complained of recurrent symptoms of instability in more than 20 episodes over 5 months during military service. The diagnosis of the referring medical officer was recurrent dislocation of elbow and loose body. Routine physical examination was stable clinically, except when full extension of the elbow and supination of the forearm was attempted. Even under general anesthesia, no sign of valgus or varus instability was found except in the pivot shift test of elbow. An X-ray showed a small osteochondral fragment around the lateral epicondyle of the elbow.

1. Pivot shift test for posterolateral rotatory instability[1~4]

This test produces rotatory subluxation in the ulnohumeral joint holding the wrist, keeping the forearm fully supinated starting from the extended elbow to slight flexion while applying valgus axial compression and supination momentum. This creates a semi lunar notch in the ulnar, separated with radius from the humerus posterolaterally. At 30-40 degrees flexion, maximal separation occurs which demonstrates posterior prominence (subluxated radius and ulnar from humerus) and a skin dimple proximal to radial head (Fig. 1). The radiograph reveals posterolateral subluxation in the radial head and marked widening in the ulnohumeral articulation due to the rotatory subluxation (Fig. 2). As the elbow is flexed to 40 degrees or more, radiohumeral joint reduction together with ulnohumeral joint reduction occurs with a visible palpable clunk (Fig. 3).

Fig. 2 Lateral radiograph simultaneously with photograph in Fig 1.
Posterolateral subluxation in the radial head and marked widening in ulnohumeral articulation due to rotatory subluxation.

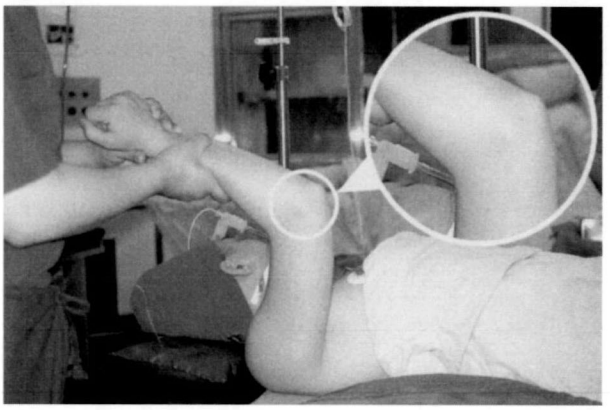

Fig. 3 As the elbow is flexed 40 degrees or more, the radiohumeral joint reduction together with ulnohumeral joint reduction occurs with a visible palpable clunk.
Disappearance of skin dimple (circle in the right).

2. Operative treatment[5)]

The ulnar part of the radial collateral ligament was reconstructed using the palmaris longus tendon.

Technique of reconstruction of the ligament : The elbow was approached through a modified Kocher incision. The common extensor origin was elevated to reveal the origin of the ligament complex at the lateral epicondyle and distally between the anconeus and extensor carpi ulnaris, the supinator crest of the ulnar was exposed. An excessively stretched posterolateral capsule was observed. However, no definite ulnar collateral ligament was observed which is an essential lesion in posterolateral rotatory instability.

The pivot shift test showed subluxation in the radial head with a stretched and redundant posterior capsule of the radiohumeral joint (Fig. 4). Reconstruction was done using the autogenous palmaris longus tendon. Creating the holes for the anchor system (MITEK, G-II Linvatec, USA), one proximally at the anatomic site of attachment (isometric point of lateral epicondyle) and the other distally just posterior to the supinator crest of the ulnar, the palmaris longus graft was placed posterior to the radial head. The length of tendon needed was approximately 3.5 cm.

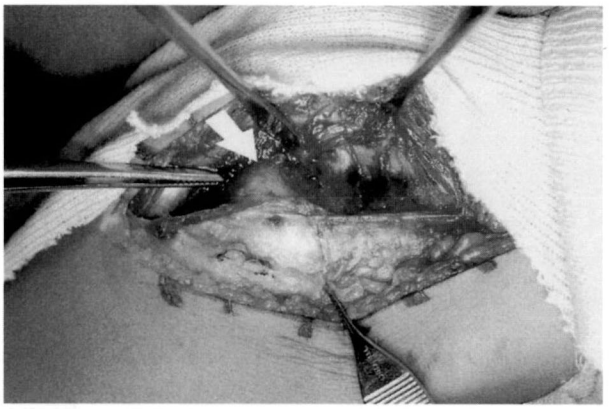

Fig. 4 Lateral view of the right elbow at surgery.
Through a modified Kocher approach, retracting the extensor carpi ulnaris anteriorly, the anconeus was reflected posteriorly. The positive pivot shift test revealed posterolateral subluxation in the radial head and laxity in the overlying capsule (white arrow).

Holding one tied knot at the distal point and keeping its tension, a proximal suture knot was tied at 30 degrees elbow flexion (Fig. 5). The exact placement of the tendon was determined during the operation to avoid any impingement.

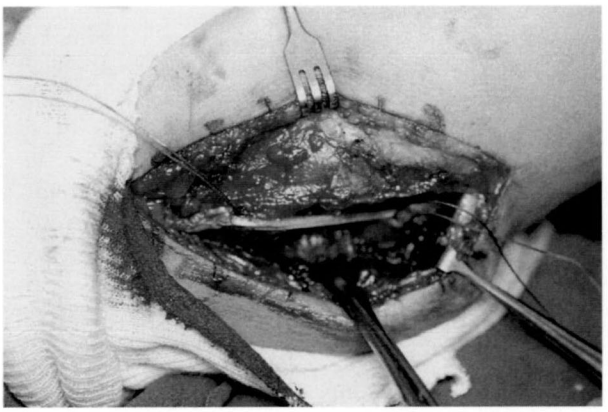

Fig. 5 Lateral view of the right elbow at surgery. Reconstruction of the lateral ulnar collateral ligament using the palmaris longus. Suture anchor at the proximal and the distal isometric points with the tendon graft placed posterior to the radial head.

3. Post-operative care

The elbow was immobilized in a long arm cast for 6 weeks with 90 degrees flexion and pronation state. Then a hinged posterior splint was applied to start active elbow exercise, which prevented extension beyond 30 degrees for 4 weeks. Then a splint was worn for another 4 weeks.

4. Results and follow-up assessment

The result was assessed with respect to stability and range of motion. At 4 months after the operation, the elbow had gained almost full range of motion with no pain and no subjective symptom of instability (Fig. 6). Objective posterolateral instability was negative. A long-term follow-up to monitor the suture anchor system longevity is necessary.

Discussion

Recurrent posterolateral rotatory instability in the elbow is caused by trauma, surgical violation of the lateral ulnar collateral ligament in tennis elbow or repeated over-loading in the cubitus varus. O'Driscoll et al thought that the pathoanatomy of the elbow instability was a circle of soft tissue and bone disruption from the lateral to medial staging from 1 to 3. Thus dislocation is the final stage 3 of the instability, starting from posterolateral instability to complete dislocation[6]. The cause by inadequate healing of the lateral collateral ligament complex compared to medial remains unclear.

The lateral collateral ligament complex has been overlooked compared to the medial because of the bony and muscular constraint such as anconeus and

Fig. 6 Lateral radiographs at 4 months after the operation, almost full range of motion was gained.

common extensor[7]. The course of the radial collateral ligament is fan shaped, and poorly demarcated from lateral epicondyle into the annular ligament[8]. It is thought to be the main stabilizer of varus force. But the lateral ulnar collateral ligament was revealed to be the main constraint to posterolateral rotatory instability kinematically by O'Driscoll et al[2]. However Kim et al reported the functional anatomy of the lateral ulnar collateral ligament, and there was vestigial LUCL (lateral ulnar collateral ligament) and no LUCL[9]. In our study, we could not identify a definite ligament structure originating from the lateral epicondyle to the supinator crest. Thus, this case might be vestigial or no LUCL type. Only the posterolateral capsule was redundant and overly stretched, which is known as the 2nd restraint to posterolateral instability[2, 5].

Patients with posterolateral instability usually complain of instability, locking, painful click and snapping of the elbow[10]. The pivot shift test was performed with the use of local anesthesia, this elicits frank subluxation clinically and radiographically. The test is applicable for an awake patient but is more successful under general anesthesia. This test is not easy one because of its rarity but once it has been practised it can be reproducible and is most sensitive[1].

The goal of the treatment is to restore functional integrity to the lateral ulnar collateral ligament. O'Driscoll et al made the tendon graft threaded into the bone tunnel and sutured to fix the tendon graft[5], but we fixed the tendon graft using a commercial suture anchor system (MITEK GII, Linvatec, USA) with its initial pull-out strength in the operation field. The biomechanical test is expected to compare the security and strength of the fixation materials.

Summary

The pathoanatomy of posterolateral rotatory instability appears to be insufficiency in the ulnar collateral ligament. Diagnosis is difficult, but it can be diagnosed using the pivot shift test for posterolateral rotatory instability. The goal of treatment is to restore the functional integrity to the lateral ulnar collateral ligament. Here we have presented our approach to restore the functional anatomy to the ulnar part of the radial collateral ligament using the palmaris longus, for successful treatment of recurrent posterolateral rotatory instability.

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第5回日韓整形外科スポーツ医学会発表論文

Modified Transglenoid Suture Reconstruction of an Anterior Labroligamentous Periosteal Sleeve Avulsion (ALPSA) Lesion

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Sang Yun Chung

● Key words
Shoulder instability : Anterior labroligamentous periosteal sleeve avulsion (ALPSA) : Modified transglenoid suture technique

● Abstract

Introduction : Thirty-two cases of anterior labroligamentous periosteal sleeve avulsion (ALPSA) were found in the treatment of recurrent anterior shoulder instability, between January 1988 and March 1998 and were followed for a minimum follow-up of two years.

Methods : The average age at operation was twenty-seven years. There were 26 men and 6 women. All patients were treated with our modified transglenoid suture technique. After liberation of the anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion, we classified the type of lesion into Rhee's classification of Bankart lesion (type Ia, b-IVa, b), according to the liberated status of the inferior glenohumeral ligamentolabral complex. We performed reattachment of the detached glenohumeral ligamentolabral complex to the glenoid neck according to our modified transglenoid suture technique.

Results : None of the 32 patients experienced any intra-operative complication or infection. All patients had nearly full, painless range of motion and had no recurrence. Among the 32 cases, a satisfactory result was obtained in 30 cases according to the Rowe rating scale.

Discussion and Conclusion : We found various types of anterior labroligamentous periosteal sleeve avulsion (ALPSA) arthroscopically, and our proposed classification and modified transglenoid capsulolabral reconstruction could be applied to each type of anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion. So, in the classification and treatment of anterior labroligamentous periosteal sleeve avulsion (ALPSA), we propose our new classification and modified arthroscopic transglenoid capsulolabral reconstruction.

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Introduction

Traumatic recurrent anterior glenohumeral instability is a common clinical problem that can lead to significant disability. Perthes and Bankart have described a lesion in the anterior inferior labroligamentous structures related to anterior unidirectional dislocations and subluxations in the shoulder known commonly as a "Bankart lesion"[1, 2]. This lesion presents as an avulsion in the anterior inferior glenohumeral ligament and labral complex from the anterior rim of the glenoid. The anterior scapulae periosteum ruptures and allow the labral complex to float anterior to the glenoid with an obvious space between it and glenoid rim.

The clinical literature has indicated the Bankart lesion is the most common pathology[3～6]. The incidence of this lesion has ranged from 45 to 100 percent in series that have been reported since 1948. But many studies revealed that other pathology could lead to anterior glenohumeral instability. With the advent and advancement in shoulder arthroscopy. A newly described lesion with anterior shoulder instability has recently been noted by Neviaser[7] in his recognition of the anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion, and Wolf's[8] documentation of the humeral avulsion in a glenohumeral ligament (HAGL) lesion. Some authors have observed that capsular laxity[8, 9] and a midcapsular tear can cause anterior shoulder instability. An ALPSA lesion is similar to a Bankart lesion but differs in that the anterior scapular periosteum does not rupture, and the anterior glenohumeral ligament, labrum, and anterior scapular periosteum are stripped and displaced in a sleeve-type fashion medially on the glenoid neck as well as inferiorly rotated.

We have seen many cases of ALPSA lesion, and this lesion represents a cause for recurrent instability with specific findings. It requires a different approach for repair.

The purpose of this study is to present the incidence of APLSA lesion in TUBS, and present the treatment for a ALPSA lesion, especially the transglenoid suture technique.

Materials and Methods

Between January 1988 and March 1998, we operated on 204 patients with a diagnosis of traumatic anterior instability in the glenohumeral joint. We have examined the case notes, and operative reports. Of those with anterior shoulder instability, an ALPSA lesion was seen in 32 patients. The average follow-up duration was 38 months (range 24 to 84 months). 26 were men, and 6 were women. The mean age at operation was 27 years (range 16 to 64 years). At operation, 3 patients had an interval of 1 year after the initial dislocation, 6 patients had an interval of 2 years, 5 patients an interval of 3 years and 17 patients had an interval of more than 4 years. Regarding the frequency of dislocation, 12 patients had experienced dislocation about 10 times per 1 year, 15 patients on average 20 times per 1 year, and 7 patients had experienced dislocation more than 20 times per year.

The APLSA lesion was repaired to the anterior rim of the glenoid by modified transglenoid suture reconstruction (Rhee's method). In an ALPSA lesion, the labrum was not in its anatomic position but displaced medially and inferiorly rotated. The synovialized fibrous tissue appears labrum. The entire complex of superficial synovium, fibrous tissue, labrum, anterior inferior glenohumeral ligament, and anterior scapular periosteum must be dissected from the glenoid beginning in the crease just anterior to the glenoid rim from 2 to 6 o'clock in the right shoulder and from 10 to 6 o'clock in the left shoulder. This mobilization is of importance. Dissection is performed using a periosteal elevator through a routine portal. Release of the labroligamentous structure from the anterior medial glenoid neck transforms the ALPSA lesion to a Bankart lesion (Fig. 1, 2). After mobilization, this lesion is classified into Rhee's classification of Bankart lesions (Table 1).

Fig.1 Initial findings of an anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion.

Fig. 2 Arthroscopic findings after release of the labroligamentous complex from the glenoid rim.

Table 1 Rhee's classification of Bankart lesion

Type I : Separation of labrum and inferior glenohumeral ligament from the glenoid rim and scapular neck (Classic Bankart lesion)
Type II : Separation of labrum with glenoid rim fracture
Type III : Type I or II Bankart lesion with type II SLAP* lesion
Type IV : Deficient labrum with detached loose inferior glenohumeral ligament from the scapular neck
Subgroup "a" : without capsular laxity
Subgroup "b" : with capsular laxity

* SLAP : tear in the superior labrum anterior to posterior.

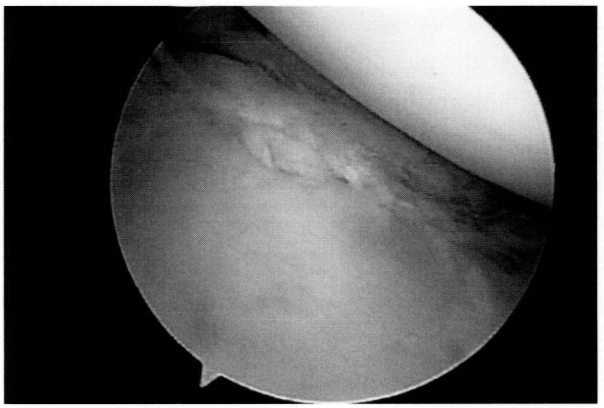

Fig. 3 Postoperative findings after the transglenoid suture technique.

The detached glenohumeral ligamentous complex is reattached to its original position on the anterior glenoid rim by capsular shift through the modified transglenoid suture technique by Rhee according to its type (Fig. 3). Multiple sutures were placed through the labral tissue (7 to 14 stitches). And then transglenoid drill holes were made using our special drill guide. All the sutures were passed through a transglenoid drill hole out through the scapular spine posteriorly. The labral complex is tightened by pulling the labroligamentous complex superior to its origin on the anterior glenoid rim. The sutures were tied over on the bone (scapular spine). After mobilization, there was usually capsular laxity. There was no subgroup "a". Two cases were type Ib, 3 cases were type IIb, 5 cases were type IIIb, and 22 cases were type IVb. Postoperatively, the shoulder was immobilized for 5 to 6 weeks. After 5 weeks, passive and active range of motion (ROM) exercises were begun.

Results

The follow-up ranged from 24 months to 84 months, and averaged 38 months. Evaluations at the most recent follow-up with Rowe rating scale[10] were compared with the score obtained by assessment of preoperative symptoms, functions, and

motion. The parameters of pain, motion, strength, stability, and function were independently assessed, and an overall score was determined. After surgery, a satisfactory result was obtained 30 cases.

All patients showed nearly full, painless ranges of motion, and there was no functional restriction in ROM. None of the 32 patients experienced any intraoperative complication, postoperative complication, or infection. There were 2 cases of recurrence. They recurred after a retrauma in the shoulder. We thought that in the case of a reversed pear-shape glenoid, recurrence was easy to occur. This type of glenoid is due to a bony defect in the glenoid (Fig. 4).

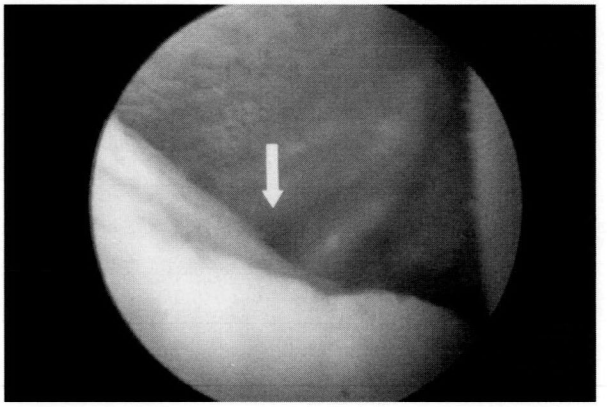

Fig. 4 Pear-shaped glenoid.

Discussion

The clinical literature has indicated that capsulolabral separation from the glenoid (Bankart lesion) is the most common pathology[1, 3~6, 10~12]. However some authors have observed capsular laxity, actual humeral insertion avulsion, or an ALPSA lesion[7~9, 13~15].

The condition of humeral capsular avulsion was first described by Nicola[12] in 10 cases of anterior shoulder instability, and Bach et al[16] reported two cases. Wolf et al[8] described six such cases among 64 shoulders undergoing arthroscopy and treatment for traumatic shoulder instability. They described this injury as a humeral avulsion in the glenohumeral ligaments (HAGL lesion) and observed it in 9% of the cases of traumatic anterior shoulder instability. Boker et al[13] also described HAGL lesion. In his cases, the incidence of a HAGL lesion was 39%. Oberlander et al[14] described a variant anterior shoulder instability. This variant was a bony humeral avulsion in the glenohumeral ligaments (BHAGL lesion). They reported 3 cases. Another author reported a combined Bankart lesion and HAGL lesion associated with anterior shoulder instability[15].

Glenohumeral ligament dysfunction is also at the heart of an ALPSA lesion. The anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion like Bankart lesion, destabilizes the anterior inferior supporting structures of the joint[7]. However, unlike the Bankart lesion, which is characterized by a rent between the labral complex and the glenoid rim, in the ALPSA lesion the anterior inferior glenohumeral ligaments along with the labrum and the anterior scapular periosteum avulse and are displaced in a sleeve-like manner across the anterior glenoid neck.

In the treatment of an ALPSA lesion, mobilization is of importance. Release of the labroligamentous structures from the anterior medial glenoid neck transforms the ALPSA lesion to a Bankart lesion. This tissue is then reconstructed to its original position on the anterior glenoid rim by capsular shift. We think arthroscopic capsular shift is a suitable method for the capsular shift. There are two types of arthroscopic capsular shift. One is the anterior anchor system and the other is a transglenoid suture technique. In the literature, many cases have been reported involving a capsular shift with anterior suture anchor, or the transglenoid suture technique[17~20].

In our cases, the modified transglenoid suture technique was more effective and safer than the anterior anchor system. There are some problems in the original transglenoid suture technique. Medialization of the labroligamentous complex, only 1 or 2 points for capsulolabral fixation to glenoid rim, insecure fixation due to soft fixation point posteriorly over infraspinatus fascia, absorbable suture and suprascapular nerve injury are the main problems in

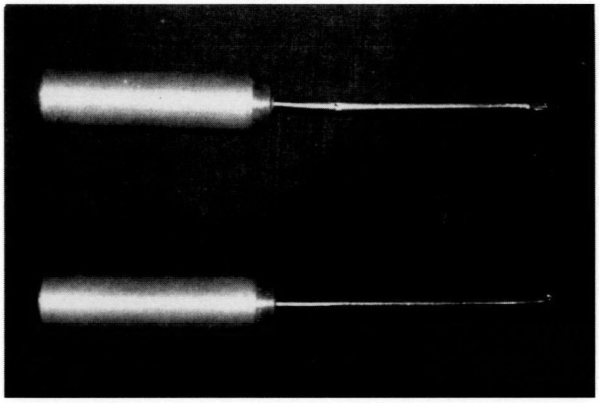

Fig. 5 Special drill guide.

the transglenoid suture technique.

We have modified the transglenoid suture technique. We use a special simple drill guide (Fig. 5). Using this special drill guide, we can avoid medialization, make a bump effect in the reconstructed labrum, and find a safe zone for the suprascapular nerve. And also we can reconstruct the labrum in the correct anatomical position. In our modification, we use multiple 7 to 14 sutures and securely tie them accross the bony scapular spine instead of the infraspinatus fascia. In situ suture, plication, advancement and capsular shift are possible in this modified transglenoid suture technique. We can also use nonabsorbable suture. Advantages of Rhee's method are no hardware problem, reasonably low recurrence rate with few complications, generally reproducible for most surgeons, and easy to convert failure to rearthroscopic or open surgery.

Conclusion

The incidence of an ALPSA lesion in traumatic anterior instability is 15.7 %. There were various shapes of an ALPSA lesion. In the treatment of an ALPSA lesion, first the ligamentous structures are fully mobilized from the anterior medial glenoid neck, which makes the ALPSA lesion into a Bankart lesion. And then a capsular shift is performed for anatomical reconstruction of the labrum, correction of the capsular laxity, and reduction in the axillary pouch. Rhee's modified transglenoid suture technique is a safe and effective method for an ALPSA lesion.

We recommend our modified transglenoid suture technique because this method requires no special implant and no special instruments except a simple drill guide, and it can reconstruct any type of capsulolabral lesion, such as Bankart lesion, type II slap lesion, or ALPSA lesion, as well as the capsular laxity including AMBRI.

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第5回日韓整形外科スポーツ医学会発表論文

Physical and Radiological Surveys for Low Back Pain in High School Baseball Players

高校野球選手に対する腰痛調査

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●Key words
Low back pain : Baseball player : Trunk muscle strength
腰痛，野球選手，体幹筋力

●Abstract

The purpose of this study was to investigate the incidence of low back pain in high school baseball players and to examine the relationship between low back pain and trunk muscle strength.

The subjects were 46 male high school baseball players. We used a questionnaire, physical findings of the lumbar spine, X-ray and trunk muscle strength using a Myoret system to investigate low back pain.

Eighteen players complained of low back pain at the time of the survey, and twenty-six had a past history of low back pain. On X-ray examination, twenty-one were found to have lumbar lesions, including spondylolysis, naturally repaired spondylolysis, narrowed disc, and facet joint thickening. Trunk muscle strength tests showed that the isokinetic extensors values were markedly decreased in the players with low back pain.

●要旨

目的：高校野球選手を対象として，腰痛および腰椎単純X線上で所見を有する選手の割合や，腰痛と体幹筋力との関連を検討した。

対象および方法：3高校の野球部員に対し，アンケートにて野球歴や野球による障害・外傷の既往などを調査した。腰痛については詳細に病歴を聴取し，全員の腰椎単純X線写真を撮影した。体幹筋力測定も全員に施行し，屈曲・伸展および回旋筋力について等尺性・等速性筋力を測定した。

結果および考察：46名について結果が得られ，調査時に腰痛を認めた選手は18名，腰痛

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の既往がある選手は26名であった。腰椎単純X線にて所見を有する者は21名であり，腰椎分離症，腰椎分離後の椎弓の硬化，椎間板の狭小化などであった。体幹筋力は調査時に腰痛を認める群では等速運動での伸展筋力が有意に低下していた。回旋筋力においても腰痛を認める群が若干筋力が少ない傾向にあった。

Purpose

Low back pain is common among young athletes. Here, we have investigated the incidence of low back pain among high school baseball players, the incidence of those with an abnormality in the lumbar spine on plain radiograms, and the relationship between low back pain and trunk muscle strength, in Kochi Prefecture with the cooperation of the Kochi Prefecture Baseball Liaison Conference.

Subjects and Methods

The subjects were members of the baseball clubs of 3 high schools in Kochi Prefecture. The 3 schools were among the best 4 in the prefectural high school baseball tournament nearly every year. The supervisors of the baseball clubs were cooperative with this investigation, and their players visited the outpatient clinic of our hospital.

First, each player's history of playing baseball, history of playing different positions, history of disorders or injury caused by baseball, present condition, and amount of workout were investigated using a self-report questionnaire.

Next, an orthopaedic medical check including physical and plain radiographic examination of injury sites and measurement of the trunk muscle strength were carried out. An orthopaedic surgeon carefully interviewed each player in regard to his medical history, particularly in regard to low back pain. A-P, lateral, and both oblique angle plain radiograms of the lumbar spine were taken for each player regardless of the presence or absence of low back pain.

The trunk muscle strength was also measured in all subjects, and the isometric muscle strength and isokinetic muscle strength at angular velocities of 60° and 90° were measured in the flexor, extensor, and rotator muscles of the trunk, using a Myoret system.

The costs of the physical examination and of the imaging examinations concerning sites that showed a clear disorder were covered by medical insurance, and the portion of the medical costs usually paid by the patient was paid by the research fund of our department. The costs of the examinations of the normal sites were entirely paid by our department.

Results

At the time of writing, findings from 46 members of the baseball clubs of the 3 high school have been obtained. Their mean age was 16 years (15-18 years). Eighteen (39.1%) of them had low back pain at the time of the examination, and 26 (56.5%) had a history of low back pain (Table 1). Abnormalities were observed on plain radiograms of the lumbar spine in 21 players (45.7%). It was lumbar spondylolysis in 8, hardening in the lamina after lumbar spondylolysis in 9 (confirmed by CT scan), narrowing in the intervertebral disc in 3, thickening in the intervertebral joints in 1 (confirmed by MRI) (Table 2). If the diagnosis was difficult using plain radiography alone, a CT scan and MRI were also performed with the consent of the players, and the images were used as references. A CT scan is useful for the diagnosis of lumbar spondylolysis, and reveals hardening or ballooning in the vertebral arch after spondylolysis. Although the presence or absence and the site of low back pain were fairly consistent with findings on plain radiograms, some play-

Table 1 Questionnaire results

46 players of baseball clubs of 3 high school
Mean age ; 16 years old (15 - 18 years old)

At the time of examination,

Low back pain (+) ; 18 players (39.1 %)
Low back pain (−) ; 28 players (60.9 %)

History of low back pain (+) ; 26 players (56.5 %)
History of low back pain (-) ; 20 players (43.5 %)

Table 2 Findings from plain radiograms (46 high school baseball players)

- Lumbar Spondylolysis : 8 players
  - Bilateral + listhesis : 6 players
  - Bilateral : 1 player
  - Right : 1 player
- Hardening or Ballooning in the Lamina : 9 players
  (All players were confirmed by CT scan)
- Narrowing in the Intervertebral Disc : 3 players
- Thickening in the Intervertebral Joints : 1 player

Total of Abnormalities on Radiograms : 21 players (45.7 %)

ers with clear pseudoarthrosis-type lumbar spondylolysis had no low back pain in the past or at the examination, and a few players with low back pain that interfered with practice exhibited no clear abnormality on imaging studies.

Concerning the results from the measurement of trunk muscle strength, no significant difference was observed in the peak torque of the flexor and extensor muscles on isokinetic and isometric exertion in the group that had low back pain at the time of examination compared with the group with no low back pain (Fig. 1).

The flexor/extensor muscle strength ratio was clearly higher in the group with low back pain on isokinetic exertion, probably indicating the relative weakness of extensor muscles (the back muscles), in dynamic exercise. No significant difference was observed between the two groups on isometric exertion (Fig. 2).

The strength of trunk rotation to the left (direction of rotation in batting and throwing) tended to be weak in the right-handers, while the strength of rotation to the right tended to be weak in the left-handers, in the group with low back pain (Fig. 3). The peak torque of the rotator muscle strength was slightly weaker in the group with low back pain, but the difference was not significant.

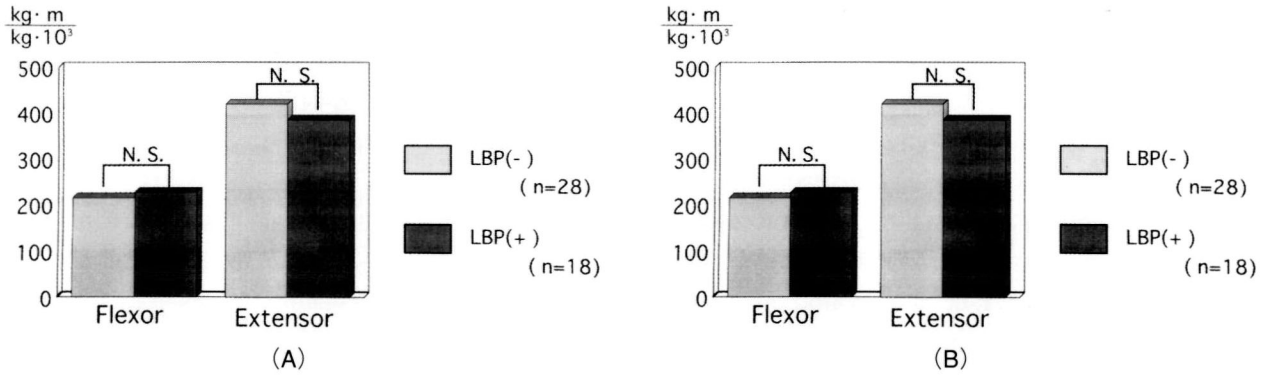

Fig. 1 (A) Max. isokinetic torque.
(B) Max. isometric torque. No significant difference was observed.

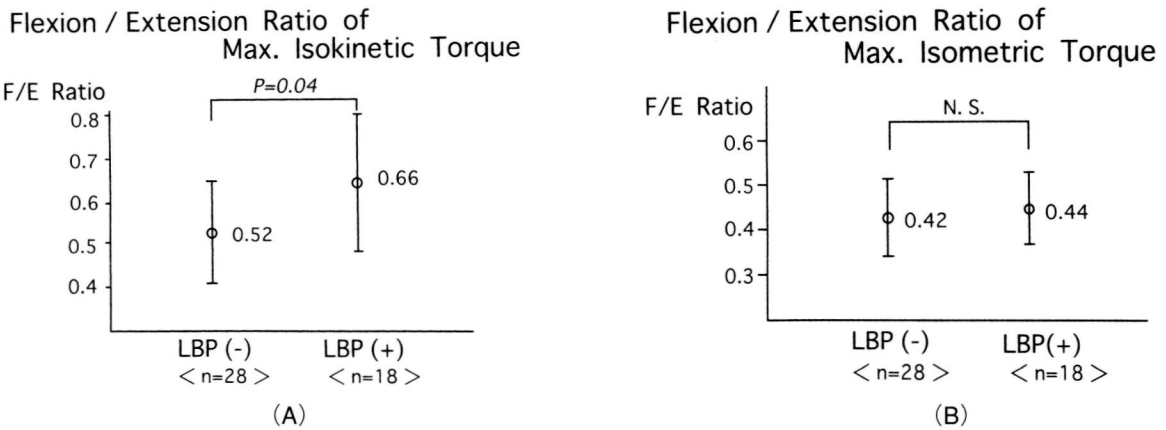

Fig. 2 Flexion/extension ratio.
(A) Clearly higher in the group with low back pain on isokinetic exertion.
(B) No significant difference was observed between the two groups on isometric exertion.

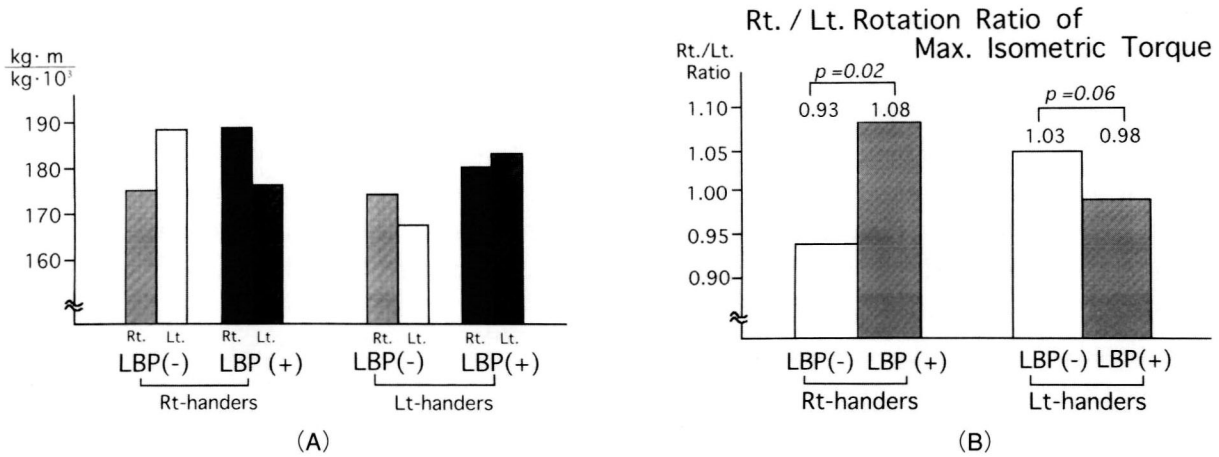

Fig. 3 Results of trunk rotation strength.
(A) Max. isometric torque.
(B) Players with low back pain showed reduced rotator strength in their direction of batting and throwing.

Discussion

Although we noted a marked correlation between the radiographic findings of the lumbar spine and the subjective symptoms of low back pain, there were some exceptions. Some players, whose plain radiographic images or CT scans did not reveal any abnormalities notwithstanding their subjective symptoms of pain, complained of muscular/musculomembranous pain. Since all of them noticed the symptoms only recently, we instructed each of them to perform stretching exercises and training to strengthen the abdominal, back and musculature around the hip joint.

In the measurement of flexor and extensor strength, the players with low back pain were found to have relatively reduced extensor strength, which we thought was due to the related pain caused by the closer proximity of the lumbar and back musculature. Another cause may be that the back muscle was mainly affected by the nervous system of the lumbar, while the abdominal muscle was also affected by the nervous system of the thoracic as well[1]. In previous studies, most authors have found the extensors to be more affected than the flexors[2~5].

In the measurement of the flexor/extensor and rotator strength between the group with low back pain and the group without low back pain, a significant difference was detected not in peak torque but in respective muscle strength ratio. This could be explained by the presence or absence of low back pain causing a significant difference in the muscle strength ratio, which reflects the respective muscle strength balance. The absolute value of torque, which offsets the difference caused by the presence or absence of low back pain, shows no significant difference because the value reflects the ability of each individual player.

In the measurement of rotator strength, the players with low back pain showed reduced strength in their direction of batting and throwing. We thought that this was because the players without low back pain tend to have more strength in their direction of batting and throwing, while those with low back pain have reduced muscle strength because pain results in the disuse of the muscle.

Moreover, because baseball is a sport that always requires rotator strength in the same direction, overuse of the musculature is caused by its repeated rotation, which causes the reduction in muscle strength. The investigation into the correlation between plain radiographic images and trunk muscle strength revealed no significant differences among the cases. However, the 8 players with an abnormality on radiographic images —lumbar spondylolysis and spondylolytic spondylolisthesis— showed a marked reduction in trunk muscle strength, particularly in extensor (back muscle) strength compared with the normal group. The players with lumbar spondylolysis also showed reduced rotator strength, which may have been affected by the reduced extensor strength.

As discussed above, we are not yet able to confirm whether low back pain caused or resulted from the reduction in trunk muscle strength, but the results of our study show that they were correlated. In the group with low back pain, we thought that an organic lesion such as lumbar spondylolysis caused the muscle shrinking due to denervation in the nerves governing the extensor, resulting in the reduced muscle strength. We also supposed that low back pain occurred in high school players, who are still growing and do not yet have fully developed muscle strength, through the overuse of the musculature during excessive training, and we intend to investigate this further in future studies.

Conclusion

Players with low back pain have relatively weaker back muscles, causing reduced rotator strength in their direction of batting and throwing.

It is important for players to be aware of low back

problems, to try and train so as to acquire the proper muscle balance for each player, and for this to be fully supported by their team directors.

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第5回日韓整形外科スポーツ医学会発表論文

Arthroscopic Meniscal Repair : Effects of Suture Material and Suture Technique

鏡視下半月縫合術の治療成績
—縫合材料と縫合方法の影響—

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●Key words
Arthroscopy : Meniscus : Repair
関節鏡，半月，縫合

●Abstract
The purpose of this study was to evaluate the results of arthroscopic meniscal repair by second-look arthroscopy. Forty-six patients with 53 meniscal repairs were evaluated. All repairs were completed in conjunction with ACL reconstruction. Thirteen menisci were repaired using horizontal mattress with absorbable sutures and 13 using vertical mattress with absorbable sutures. Another 27 were repaired using a vertical technique with both absorbable and nonabsorbable sutures. According to Cannon's evaluation criteria, 66 % were considered completely healed, 19 % were incompletely healed, and 15 % menisci were not healed. The suture material was significantly correlated with failure to heal ($p = 0.02$) : seven failures (27 %) were observed in the group with only absorbable sutures, while only one failure (4 %) occurred in the combined suture group. Although meniscal healing did not significantly differ between the horizontal and vertical mattress technique using absorbable sutures, we concluded that the deterioration in suture materials, not the suture technique, affected the clinical outcome.

●要旨
縫合材料と縫合方法の違いが半月縫合術の治療成績に与える影響について検討した。対象は，吸収糸による水平マットレス縫合が13半月，垂直マットレスが13半月で，吸収糸と非吸収糸を併用した垂直マットレス縫合が27半月であった。全体の治癒率は，完全治癒66％，不完全治癒19％，癒合不全15％であった。縫合糸別では，癒合不全は吸収糸単独使用例が27％，非吸収糸併用例では4％であった（$p = 0.02$）。吸収糸を用いた水平マットレスと垂直

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マットレスの結果からは，縫合法の違いによる治癒率に差はみられなかった。これは，縫合糸の固定力が術後早期に失われたために断裂部が治癒せず，縫合材料が治癒成績に影響を与えた可能性がある。

Introduction

The importance of preserving meniscal tissue in the knee is now established. Numerous investigators have reported successful meniscal repair using horizontal and vertical mattress sutures with the inside-out technique, and with the outside-in technique[1~8]. We initially performed arthroscopically assisted meniscal repair using the horizontal mattress technique with absorbable sutures, and in 1995 began utilizing the stacked suture technique, in which vertical mattress sutures with absorbable sutures were placed in the superior and inferior surfaces of the meniscus in an alternating fashion. Then in 1996, we began to employ the stacked suture technique using both absorbable and nonabsorbable sutures.

Many factors that affect the results of meniscus repair have been reported[1~8]. These include the age of the patient, the sex, the delay in repair from the time of injury, the side of the tear, the location of the tear, length of the tear, and the stability of the anterior cruciate ligament. However, there are few reports comparing the difference in meniscus suture materials and suture techniques[1, 2]. The purpose of this study was to evaluate suture materials and techniques, and their effect on healing after meniscal repairs in 53 menisci, using second-look arthroscopy.

Materials and Methods

Between April 1994 and September 1997, 89 patients received a total of 103 arthroscopic meniscal repairs, in our hospital. Forty-six patients with 53 repairs among them underwent second-look arthroscopy at the time of hardware removal after ACL reconstruction. All these tears were longitudinal or double longitudinal, and were repaired at the same time as ACL reconstruction. The average age of the patients was 23 years (range from 14 to 46 years). There were 20 females and 26 males.

Meniscal repairs were performed at an average of 24 months after injury (range from 2 to 240 months). All menisci were repaired by the inside-out technique through a posteromedial or posterolateral incision[3, 4]. Both sides of the tear site were debrided and the synovial fringe was abraded to promote a healing response. Sutures were placed 3 to 4 mm apart on the superior and inferior surfaces using a double-lumen cannula (Smith and Nephew, Acufex, Mansfield, MA). The horizontal mattress technique was employed using 2-0 Vicryl (Ethicon, Somerville, NJ) and 2-0 Dexon (Davis & Geck, American Cyanamid Co., Manati, Puerto Rico) sutures in 13 meniscal repairs, the vertical mattress technique using 2-0 Vicryl and 2-0 Dexon sutures in another 13 repairs, and the vertical mattress technique using 2-0 PDS (Ethicon, Somerville, NJ) and 2-0 nylon sutures in the other 27 repairs. Postoperatively, the knee was immobilized in a brace. After two to three days, range of motion exercises were begun and partial weight bearing with a brace was allowed as tolerated. At 3 weeks after surgery, the patient discarded crutches and was allowed full weight bearing. Squatting and pivoting on the knee was not allowed for three months.

Second-look arthroscopy was done at an average of 18 months after the meniscal repair (range from 5 to 42 months). The degree of healing of the meniscal repair was determined using second-look arthroscopy using Cannon's criteria[5] : a meniscus was considered healed if it was healed over the full length of the tear with a residual cleft $< 10\%$ of the thickness of the meniscus, a tear that was healed over its full length with a residual cleft that was $< 50\%$ of its ver-

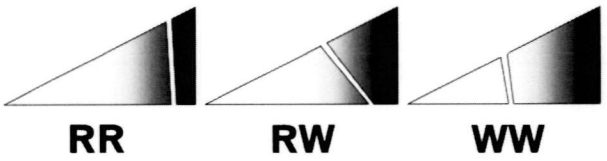

Fig. 1 The location of the tear.
The peripheral 1/3 region was defined as the red zone, and the inner 2/3 region as the white zone. Tears localized within the red or the white zone are referred to as RR or WW, respectively, and those affecting both zones as RW.

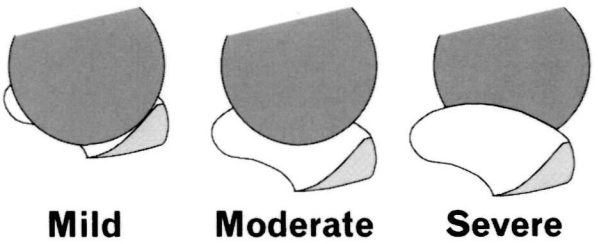

Fig. 2 The instability of the torn fragment.
Mild : The inner rim of the torn fragment did not move beyond the inferior surface of the femoral condyle.
Moderate : The inner rim moved beyond the femoral condyle.
Severe : A torn fragment was completely displaced beyond the femoral condyle.

tical height was classified as incompletely healed, and a residual cleft of $>50\,\%$ of the thickness of the meniscus at any point over the length of the tear was classified as being a failure to heal.

We analyzed the effect of eight factors on the healing of the meniscal repairs : patient age ; gender ; time from injury to repair ; repair side ; location of tear (rim width) ; instability of the torn fragment ; the suture material and the suture technique used for repair. With regard to location of the tear, the peripheral 1/3 region was defined as the red zone, and the inner 2/3 region as the white zone. Tears localized within the red or the white zone were referred to as RR or WW, respectively, and those affecting both zones, as RW (Fig. 1). The instability of the torn fragment was assessed by probing as follows : mild, when the inner rim of the torn fragment did not move beyond the inferior surface of the femoral condyle ; moderate, when the inner rim moved beyond the femoral condyle ; and severe, when the torn fragment completely displaced beyond the femoral condyle (Fig. 2).

Statistical analysis of the associated factors was performed using Fisher's exact test for significance (significance level $p<0.05$).

Results

Of the 53 menisci repaired, 35 (66.0 %) were healed completely, 10 (18.9 %) healed incompletely, and 8 (15.1 %) did not heal. These results represented an 84.9 % success rate of retained menisci (Fig. 3).

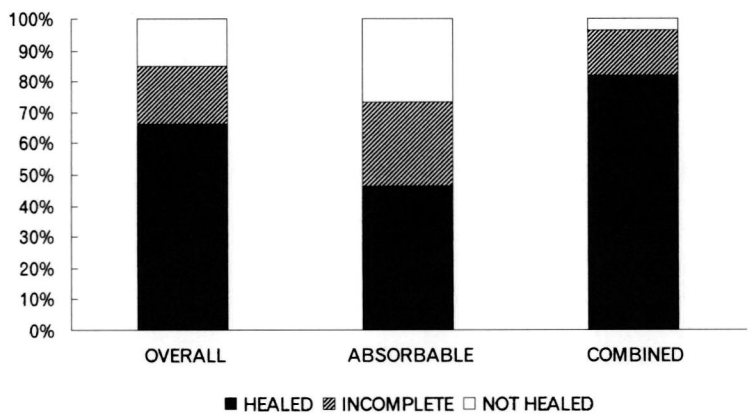

Fig. 3 Effect of the suture material on the rate of meniscal healing.

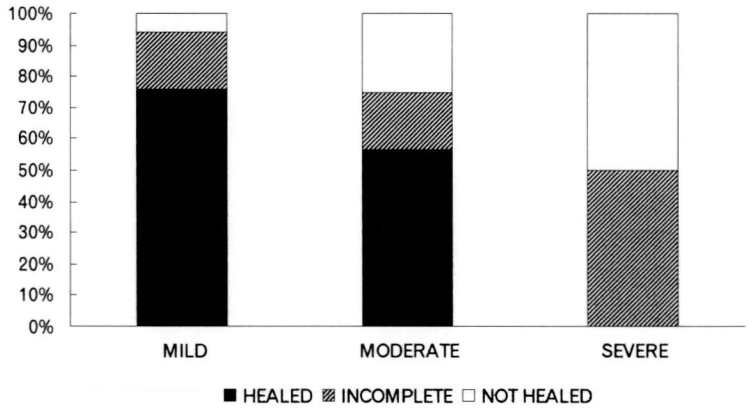

Fig. 4 Effect of the instability of torn fragment on the rate of meniscal healing.

When evaluating healing with respect to age, overall there was no statistically significant difference. Although the rate of failure was higher for patients who were over thirty years of age (12 menisci), the result was not statistically significant.

Five failures in 24 menisci were seen in the female group, and three in 29 menisci did not heal in the male group. No statistical difference was found between the two groups.

Four meniscal tears were repaired within 3 months, and 11 tears within 6 months. The variable of time to repair did not have a significant effect on healing.

Lateral meniscal tears had better healing results than medial meniscal tears, but there was no statistical difference. Of the 33 medial repairs performed, 6 (18.2 %) failed, while 2 (10.0 %) of the 20 lateral repairs failed.

Of the 29 repairs on RR tears, 3 (10.3 %) failed, and of the 21 repairs on RW tears, 4 (19.0 %) failed to heal. The tear healed completely in two of three WW menisci. In one of these two menisci, the lateral meniscus tear close to the peripheral 1/3 of the posterior segment was completely healed. Also in another case in which the tear extended from the posterior segment to the posterior horn, the lateral repair showed complete healing.

Only 2 failures (6.1 %) in the 33 repaired menisci were seen in the group with mild instability, whereas 4 (25.0 %) of 16 repairs failed in the group with moderate instability, and 2 (50.0 %) of 4 repairs failed in the group with severe instability (Fig. 4). The rate of successful healing decreased with increase in the instability of the torn fragment. Severe instability tended to have worse results than mild instability ($p = 0.05$).

The suture material was significantly correlated with failure ($p = 0.02$). Seven failures (26.9 %) in 26 repairs were observed in the group with only absorbable sutures, while there was only 1 failure (3.7 %) in the 27 repairs made in the group with both absorbable and nonabsorbable sutures (Fig. 3).

The horizontal mattress technique using absorbable sutures was inferior to the vertical mattress technique, using both absorbable and nonabsorbable sutures ($p = 0.03$). However, there was no difference in the satisfactory healing rate between these two techniques using absorbable sutures : four (30.8 %) of 13 repairs in the horizontal mattress technique using absorbable sutures failed, and 3 (23.1 %) of 13 in the group using the vertical mattress technique (Fig. 5).

Discussion

Several authors have reported meniscal repairs using absorbable as well as nonabsorbable suture materials[1~8]. There is controversy regarding the

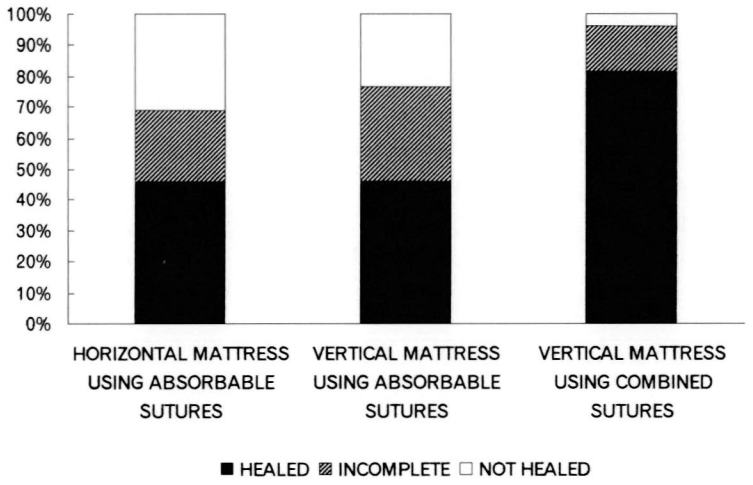

Fig. 5 Effects of the suture material and of the suture technique on the rate of meniscal healing.

suture materials to be used in meniscal repair. Nonabsorbable suture may cause abrasive joint surface damage and synovitis. Kimura et al[9] reported meniscal cysts occurring after medial meniscal repair, and Lombardo et al[10] reported a meniscal cyst forming after an all-inside repair using T-Fix (Smith and Nephew Endoscopy, Andover, MA). On the other hand, advocates of nonabsorbable suture have contended that absorbable sutures degraded before the expected meniscal healing has occurred. Second-look arthroscopy has shown no signs of cartilage surface damage.

Barber and his colleagues[11~13] evaluated the loss in strength of various suture materials when exposed to both normal and inflammatory synovial fluid in rabbit knees. Size 0 Vicryl lost all of its strength by 3 weeks, while size 0 PDS retained 68% of its original strength at 5 weeks after implantation. Moreover, the rate of loss in strength was faster in inflammatory synovial fluid than in the normal synovial fluid. Both Vicryl and Dexon suture declined to less than 10% of their original strength after 3 weeks of exposure to inflammatory fluid, while PDS retained 40% of its original strength at 6 weeks. Maxon sutures retained no significant strength at 6 weeks. Braided polyester sutures demonstrated no significant decline in breaking strength over 6 weeks. Eggli et al[1] suggested that the use of absorbable sutures alone was significantly correlated with failure. Although they did not detail the kind of suture materials they examined, 6% failure occurred in the nonabsorbable suture group, and 42% in the absorbable suture group. Barrett et al[2] reported that a 2-0 PDS suture group had 18% failure and a 2-0 Ethibond (Ethicon, Somerville, NJ) suture group had 0%. They recommended permanent sutures for meniscus repair as they appeared to assure longer and more stable fixation, permitting more complete maturation and remodeling of the meniscus.

In our study, the failure rate was 27% with absorbable sutures alone, and 4% in the group with both absorbable and nonabsorbable sutures. These results showed that the suture material selection affected the outcome of the meniscal repair. Suture material seemed to play a significant role in meniscal healing. The loads placed on the site of a meniscal repair during rehabilitation are unknown, as is the time necessary to allow meniscal tissue to heal. Since stable suture fixation appears to be a key factor in meniscus healing, the selection of the suture material is important in maintaining the fixation. For these reasons, we recommend absorbable suture

materials which last longer in a joint, or the combined use of nonabsorbable and absorbable suture materials.

The meniscus can be repaired with either vertical or horizontal mattress sutures. Korn et al[14] tested the primary stability of the meniscus suture technique on human cadaver menisci. The horizontal mattress suture involving the meniscus surface failed at 85 %, and the knot-end technique failed at 23 % of the tearing stress of the vertical mattress suture. Post et al[15] evaluated the effects of the suture technique and of the suture material in porcine menisci. They demonstrated that the pullout strength of the vertical mattress technique was greater than that of both the horizontal mattress technique and the knot-end technique, regardless of the suture material used ; these two techniques had similar load to failure. Tissue failure was predominant in the horizontal mattress and the knot-end repairs, whereas vertical mattress sutures failed predominantly due to suture breakage. The vertical mattress technique with 1-PDS had greater load to failure than 0-PDS or 2-0 Ethibond. The selection of suture material is most important in the vertical mattress suture technique and less important in the horizontal or the knot-end technique. Rimmer et al[16] investigated the meniscal suture technique in human menisci using a single horizontal, a double vertical loop, and a single vertical loop. The single vertical suture was inserted into the meniscus almost to the free edge, while the double vertical sutures were inserted into the meniscus at 2 mm beyond the tear. They recommended the single vertical loop technique which was inserted into the meniscus almost to the free edge, because the suture loop encircled the majority of the circumferential fiber. The horizontal sutures showed the lowest failure strength, which was attributed to less circumferential collagen fibers being encircled by the horizontal suture loop. Recently, Song et al[17] showed that the vertical suture was two times stronger than the knot-end suture, and significantly stronger than the horizontal suture. On the other hand, Boenisch et al[18] found no significant difference in the pull-out strength between horizontal and vertical sutures, with 2-0 Ti-Cron (Sherwood-Davis & Geck, St. Louis, MO) in fresh-frozen bovine menisci. However, vertical suture repair had a significantly higher stiffness than horizontal suture repair. They stated, therefore, that horizontal sutures were biomechanically less favorable for meniscal repair.

In this study, meniscal healing did not significantly differ between the horizontal and the vertical mattress techniques, using absorbable sutures. Nine (69 %) of 13 meniscal repairs using horizontal sutures healed satisfactorily, and 10 (77 %) of 13 repairs using vertical sutures healed satisfactorily. In both these procedures, the strength of Vicryl and Dexon sutures may have been lost in some repairs before meniscal healing occurred. We therefore concluded that deterioration in the suture materials, not the suture technique, affected the clinical outcome.

Our study demonstrated that with greater instability of the torn fragment there was a decrease in the rate of successful healing. Although several studies demonstrated that the tear length played a less important role in the healing of meniscal repairs[1, 3], the longer and more centrally located meniscus tears appear to be significantly unstable. Asahina et al[19] reported that arthroscopic identification of locking had a significant adverse effect on meniscal healing. In the present study, the failure rate was 6 % in those with mild instability, 25 % with moderate instability, and 50 % in those with severe instability. An unstable meniscal fragment is susceptible to becoming degenerative, because it is more frequently compressed between the femur and the tibia. Degenerated meniscal tears are believed to have a poorer potential for healing and not as amenable to repair. We have routinely performed a partial meniscectomy for an extensively deformed meniscus at the time of operation. Although there was less change in appearance, at second-look, of these repaired menisci, those which had been more unstable probably had intrasubstance meniscal degeneration.

Rim width is one of the most important factors in healing of meniscal repairs, because the peripheral meniscal blood supply is essential to successful healing of a repaired meniscus. A perimeniscal capillary plexus originating in the capsular and synovial tissues of the joint supplies the peripheral 10 to 25 % of the meniscus[20]. The anterior and posterior horn attachments of the meniscus are covered with vascular synovial tissue and appear to have a good blood supply. We found that two of three WW menisci had successful repairs. In one of these two, the tear extended to the posterior horn and the vascular access channel from the posterior horn may have accelerated the healing. In the other of these two, the vascularity may have been maintained, because the tear was localized close to the peripheral 1/3.

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第5回日韓整形外科スポーツ医学会発表論文

Morphological Changes in the Human Patellar Tendon after Anterior Cruciate Ligament Reconstruction Using Autologous Bone-patellar Tendon-bone

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Poong-Taek Kim
Byung-Chul Park

● Key words
Patellar tendon : Donor defect : ACL reconstruction

● Abstract

The purpose of this study was to investigate the morphological changes in the remaining patellar tendon after removal of its central one-third, using magnetic resonance (MR) imaging. We evaluated 10 patients who received arthroscopically-assisted ACL reconstruction using autologous central one-third bone-patellar tendon-bone. The mean follow-up period was 29.6 (22-40) months. The defect in the patellar tendon was left unclosed with just the paratenon being closed. We checked the thickness, width, length and cross-sectional area of the patellar tendon defect using axial MR scan.

There was no significant difference found in thickness, width, or length measurements, at follow-up. The patellar tendon defect remained in 7 cases. But 3 cases were completely filled with tendon without defect. The results indicated that the patellar tendon defect can remain for approximately 40 months after surgery. So careful harvesting of the patellar tendon is needed, and its use for revision cruciate ligament reconstruction must be carefully considered.

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Introduction

The use of a central one-third patellar tendon as an autograft for surgical reconstruction of a damaged cruciate ligament is very common. Few complications from its use have been reported. However, recent clinical studies have indicated that a decrease in quadriceps strength, range of motion, and thigh circumference along with patello-femoral problems can be associated with this procedure[1,2]. Some of these complications may result from alterations in the structural properties of the remaining patellar tendon.

The donor site regenerates after bone is harvested for a bone graft. Using MR imaging, Cross et al[3] have shown that the semitendinosus and gracilis tendons regenerate clinically and radiographically after harvesting for ACL reconstruction and repair augmentation. There are reports about the regeneration in volume, remodeling of the tendon after harvesting the central one-third, and examination of the remaining patellar tendon[4~12]. There are controversial opinions about the structural change in the donor patellar tendon. Burks et al[5] conducted a biomechanical and histological study of the patellar tendon in dog after the central 1/3 of the patellar tendon was removed. Histological studies showed that the defect in the central 1/3 of the tendon was completely filled with scar tissue with poor collagen fiber orientation. Most studies on ACL reconstruction using the patellar tendon have focused solely on the fate of the intra-articular graft.

The purpose of this study was to investigate the structural changes in the remaining patellar tendon, using MR imaging, after removal of its central one-third for use in ACL reconstruction.

Materials and Methods

Ten male patients who had each undergone arthroscopic ACL reconstruction using the central one-third of patellar tendon autograft were reviewed. The ten patients had a mean age of 24 years (range from 18 to 33 years). The mean follow-up period was 29.6 months (range from 22 to 40 months). The associated injury was a medial and lateral meniscus tear each in 3 cases, and a defect in the medial femoral condyle in another case.

1. Surgical technique

All patients underwent arthroscopically assisted ACL reconstruction using the same technique performed by the same surgeon. Standard arthroscopic portals were used, consisting of an outflow cannula placed superolaterally, along with anterolateral and anteromedial portals used for the arthroscopic and operative instruments. The skin incision was an extension from the inferior pole of the patella to a point just medial to the tibial tubercle. The paratenon was incised centrally and carefully peeled off. The central one-third (10 mm) of the patellar tendon was taken, with bone plugs both proximally and distally (Fig. 1). Both femoral and tibial tunnels were made through this inferomedial single incision. The defect in the patellar and tibia was grafted with bone from the tibial reaming. The defect in the patellar tendon was left unclosed, and just the paratenon was closed carefully with interrupted sutures of an absorbable material using No.3-0 coated VICRYL® (Ethicon, Edinburgh, UK). All wounds were then closed, and a sterile dressing applied.

Postoperatively, all patients followed the accelerated rehabilitation described by Shelbourne et al[13]. Immediately after surgery, the operated knee was placed in a continuous passive motion (CPM) machine for about 1 week. A hinged knee brace was used for about 3 months postoperatively. Crutches were used for balance and support with weight bearing as tolerated for the first weeks. At 6 weeks, use of a stationary bicycle with little or no resistance was begun. At 4 months, straight ahead running on a level surface was begun. At 6 months, agility exercises were allowed. Return to sports was allowed at 9

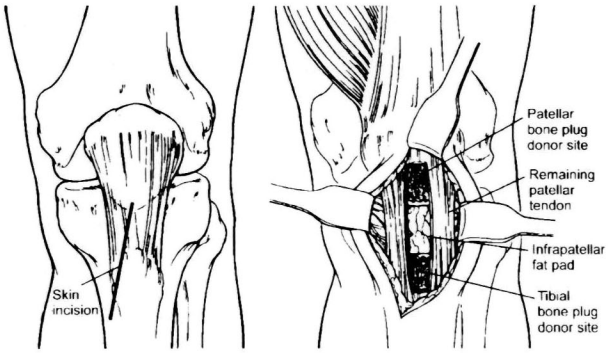

Fig. 1 Skin incision and exposure following graft harvest.

months, but the patient wore a brace during all sports activities.

2. MRI measurement

All images were taken using a General Electric 1.5 T Sigma Magnetic Resonance Scanner (General Electric Medical Systems, Milwaukee, WI) and a knee extremity coil. The knee was positioned in extension with 15° of external rotation. The field of view was 16 cm and the matrix size was 256 × 192 pixels. Axial and sagittal scans were obtained using spin echo images with a repetition time (TR) of 550 msec and an echo time (TE) of 15 msec. The width and thickness of each tendon was determined at three consistent sites (proximal one-third, middle one-third, and distal one-third) of patellar tendon by measurement on the MRI monitor screen. The average values for the width and thickness were determined (Fig. 2). The length of the middle one-third of tendon was measured (Fig. 3). The cross-sectional area of the tendon was calculated using the mathematical formula for the area of an ellipse ($\pi \times$ AB). Preoperative MRI was used as a control. Scans were reviewed independently by two radiologists and one orthopedist. All our data were statistically analyzed using Student's paired t-test.

Results

The thickness of the patellar tendon was 4.1 ± 0.4 mm preoperatively, and this increased to 4.9 ± 1.5 mm during follow-up, but there was no statistically significant difference ($p = 0.15$). The width of the patellar tendon was 30.1 ± 1.2 mm preoperatively, which decreased to 29.3 ± 2.2 mm on follow-up, but there was no statistically significant difference ($p = 0.37$). The length of patellar tendon was 43 ±

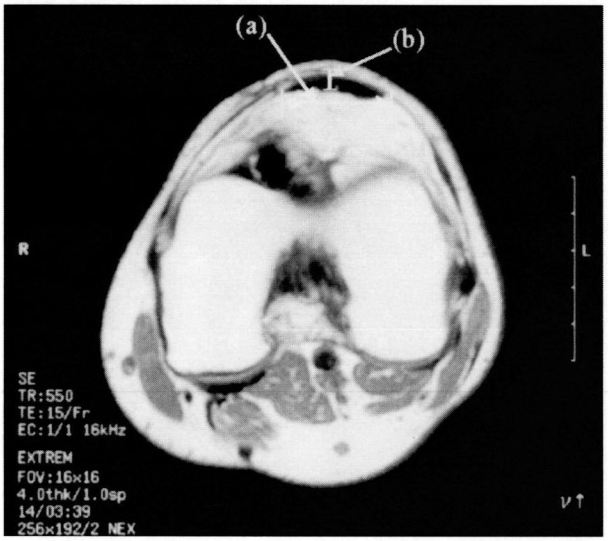

Fig. 2 Measurement of the width (a) and the thickness (b) of the involved patellar tendon, on axial scan. The tendon shows evidence of completely filled signal intensity within its central portion at 30 months after surgery.

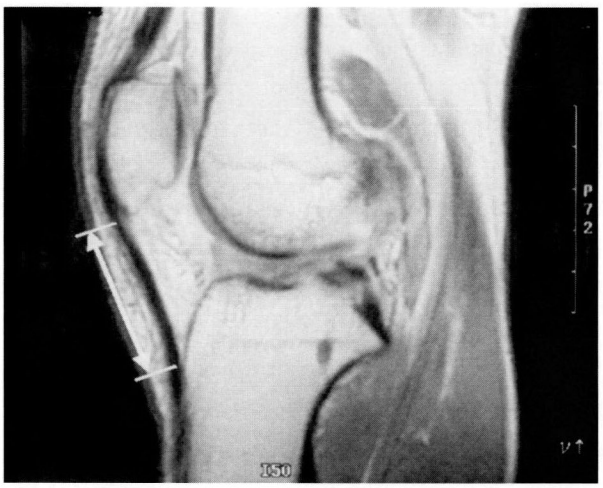

Fig. 3 Measurement of the length of the involved patellar tendon, on sagittal view.

Table 1 MRI measurements of patellar tendon

Measurements	Pre-Op (mm)	F/U (mm)	Overall Results (mm)	
			Mean Difference	0.8
Thickness	4.1±0.4	4.9±1.5	SD	1.5
			p value	*0.15*
			Mean Difference	0.8
Width	30.1±1.2	29.3±2.2	SD	2.5
			p value	*0.37*
			Mean Difference	0.5
Length	43±3.0	43.5±3.2	SD	5.2
			p value	*0.74*

3.0 mm preoperatively, and this increased to 43.5 ± 3.2 mm during follow-up, but there was no statistically significant difference ($p = 0.74$) (Table 1).

Seven of 10 cases had a defect area, and 3 cases were completely filled with tendon (Fig. 4). The mean cross-sectional area of the defect was 42.4 ± 5.9 mm^2 immediately postoperatively and 10.3 ± 5.5 mm^2 after the follow-up.

We also measured the quadriceps power and the thigh circumference. The mean decrease in thigh circumference was 2.8 ± 1.6 cm compared to the normal side. The quadriceps power measured, using one leg hop test, was 90 % that of the normal side.

Fig. 4 The tendon shows evidence of defected signal intensity within its central portion at 40 months after surgery.

Discussion

Intraarticular reconstruction of the ACL is frequently performed for patients whose knees have symptomatic deficient ACL. Arthroscopically-assisted ACL reconstruction using autologous central 1/3 bone-patellar tendon-bone is most commonly being performed. A central 1/3 of the bone-patellar tendon-bone is thought to be a good transplant material for reconstruction of the ACL because of its pretransplant strength, rigid fixation during operation, after bone plug healing and graft availability. Previous studies have focused mostly on the fate of the intraarticular graft and not on the patellar tendon defect.

There are some reports about the regeneration in volume and remodeling of the tendon after harvesting the central one-third and examination of the remaining patellar tendon[4~12]. But there are some controversies about the structural change in the donor patellar tendon.

Burks et al[5] studied the biomechanical and histological changes in the patellar tendon after removal of its central one-third. In their study, they examined the dog patellar tendon grossly, histologically, and biomechanically at three time periods postoperatively. They found a significant increase in the cross-sectional area of the tendon at 3 and at 6 months, but a decreased failure load at 60-70 % of the controls at these postoperative periods. They concluded that the canine patellar tendon had not fully recovered at 6 months after removal of its central one-third. LaPrade et al[9] assessed the histological, mechanical, and structural properties of the reharvested central-third patellar tendon in a canine model at 6 months and at 12 months. They reported that the thickness of the tendon had significantly increased, entire residual tendons were narrower and were shorter at 12 months compared with controls. The mechanical properties of the reharvested central-

third of the patellar tendon were significantly less than those of controls, at these postoperative periods. The primary patellar tendon graft did not have the same properties at up to 1 year after harvest in a canine model.

Karns et al[7] and Kartus et al[8] presented some reports of a professional football player who underwent a repeated harvest of the central 1/3 of the patellar tendon for a revision ACL reconstruction. They have shown grossly and histologically that the donor site had the potential to regenerate tissue and to recover the appearance of normal tendon. Nixon et al[14] reported that the donor site defect after ACL reconstruction using the central 1/3 of the patellar tendon was indistinguishable from normal tendon on MR imaging and histologically, and the scar in the defect progressively matured with time becoming nearly identical to normal tendon at 2 years after surgery.

Meisterling et al[10] found no difference in width measurement on MR imaging between the operative and non-operative patellar tendons at an average of 2.5 years postoperatively for a group of 15 patients who had their patellar tendon defects repaired at the time of ACL reconstruction. Coupens et al[6] found no statistical difference in the width of the donor patellar tendon at any time up to 18 months postoperatively compared with the ipsilateral patellar tendon when the defect was closed. But a significant increase in the thickness was noted at all periods during the follow-up. The cross-sectional area was on average 53 % larger when compared to the contralateral knee. In our cases, there was no significant difference in width, thickness, or in length of the patellar tendon.

Song et al[11, 12] reported microscopic studies about the patellar tendon defect using light and electron microscopy. Their results showed that the donor site of patellar tendon was replaced by fibrous scar tissue rather than tendon until 24 months after harvesting. At 24 months, the crimp pattern of collagen fibers and parallel arrangement of fibroblast to collagen fibers were still absent. The donor site of the patellar tendon was still different from normal patellar tendon in electron microscopic morphology at 24 months after surgery, regardless of the considerable maturation of the regular parallel arrangement pattern of the collagen fibril. Collagen fibril showed a unimodal distribution pattern with small diameter, but it had a tendency to have a regular parallel arrangement.

In regards to the closure of donor patellar tendon defect, Berg[4] reported that the unclosed central 1/3 of the patellar tendon after graft harvest was reevaluated at eight months later. The donor defect had healed intrinsically with hypertrophic tendinous tissue. He suggested that sutured closure of the patellar tendon donor site might be unnecessary. Shaffer and Tibone[15] used radiographs to compare the patellar tendon length after closure with that in the nonoperative limb and noted no difference between them. Burks et al[5] found no difference in mechanical properties when comparing patellar tendon defects closed or left open in a canine model at 3 and at 6 months after surgery. But there was a 10 % decrease in the length of the controls. In our cases we did not close the patellar tendon defect, and there was no significant difference in length.

Regarding the quadriceps strength, Sachs et al[2] reported that the mean quadriceps strength was 60.8 % with ACL reconstruction using patellar tendon grafts at 1 year after surgery. Tibone and Antich[16] reported on 11 patients at 2 years after ACL reconstruction with the central 1/3 of the patellar tendon. Six patients had thigh atrophy more than 1 cm. The entire group showed a 13 to 17 % deficit in quadriceps strength on the operated side as well. In our study, the mean decrease in thigh circumference was 2.8 cm compared to the normal side. The quadriceps strength was 90 % that of the normal side.

In conclusion, even though some authors[7, 8, 14] have reported the reharvesting of the patellar tendon for revision ACL reconstruction, most authors have agreed that the structural and mechanical properties

of the donor patellar tendon have not returned to normal at up to 24 months after harvest. In our study, seven of ten cases of the patellar tendon defect had not fully regenerated at an average of 29.6 months after graft harvest. Therefore, a careful harvesting of patellar tendon is needed and re-harvesting of the ipsilateral and its use for revision cruciate ligament reconstruction must be carefully considered.

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第5回日韓整形外科スポーツ医学会発表論文

Arthroscopic Treatment of Osteochondritis Dissecans in the Femoral Condyle

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Joo-Chul Ihn
Seong-Man Lee

● Key words
Femoral condyle : Osteochondritis dissecans : Arthroscopic findings

● Abstract
We have analyzed the clinical and radiological results from treatment of osteochondritis dissecans in the femoral condyle under arthroscopic guidance in young patients. The study group consisted of 19 cases, involving 17 patients. The average follow-up period was 34 months, and average age was 16 years. The cases were classified into 4 different groups, as : Group 1- stable lesion and no specific treatment after arthroscopic examination ; Group 2- early separation and multiple drilling ; Group 3- unstable lesion and Herbert screw fixation ; and Group 4- loose body removal or crater curettage. The results were analyzed according to the criteria of Hughston et al. which included clinical and radiologic outcomes. The results in the Herbert screw fixation group was better than that in other groups. In the treatment of osteochondritis dissecans in young patients, arthroscopic findings were reliable guidance for deciding the treatment method, and active fixation was recommended in skeletally immature patients with large unstable lesions.

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Introduction

Osteochondritis dissecans is separation of an articular cartilage and subchondral bone segment from the remaining articular surface. In 1888, Konig[1] was the first to term it "osteochondritis dissecans". In 1998, Williams et al[2] mentioned that osteochondritis dissecans was the separation of a bony fragment from a vascular-normal bony bed, while osteonecrosis was the separation of a bony fragment from an avascular bony bed.

Osteochondritis dissecans in the femoral condyle of the knee joint is more common than in other joints, and is also one of the most common causes of a loose body in the knee joint. Various methods including conservative therapy, curettage of the crater, multiple drilling, bone graft, loose body removal and fixation with metallic screw, Herbert screw, bioabsorbable screw, K-wire and bone pegs have been suggested for treatment of osteochondritis dissecans in the femoral condyle[3~8]. Now, the operative treatment with arthroscopy has greatly enhanced the ability to diagnose and treat osteochondritis dissecans.

The purpose of our study was to analyze the methods of treatment of the osteochondritis dissecans in the knee under arthroscopic guidance using clinical and radiological methods, especially in skeletally immature patients.

Materials and Methods

The patients who received surgery using arthroscopy from 1994 to 1999 were reviewed. All the patients were treated by one surgeon (Kyung HS) under arthroscopic guidance. The study group consisted of 19 knees, involving 17 patients (15 males and 2 females). The average follow-up period was 34 months (range 14-57 months), and the average age of the patients was 16 years (range 13-21 years). The average size of the lesions was 4.19 cm^2 (range 2.04-8.75 cm^2).

The onset of the symptoms was variable, and most showed a gradual onset involving, mostly pain and tenderness (18/19). Locking, extension limit and loose body catching was found in some cases, and the provocative test (Wilson's sign[9]) was also positive in four cases.

Five cases had a definite trauma history, usually during sports activities, while the others had only minor trauma history and insidious onset.

There were 14 cases of medial condyle involvement (74 %) and 5 cases of lateral condyle involvement (26 %). The classical site, in the medial femoral condyle just beside the attachment of the posterior cruciate ligament, was the most common site (6 cases).

The method of DeSmet et al[10] was used for MR staging of the lesion ; thickening in the articular cartilage with decreased T2 signals as stage 1, fibrous tissue surrounding the osteochondral lesion as stage 2, separation of the cartilage and increased signal on T2 behind the fragment consistent with synovial fluid as stage 3, and loose body as stage 4. Most of the cases were at stage 2 (5 cases) or stage 3 (10 cases), which means early separation and a partially detached lesion. Only 1 case was at stage 1, while 3 cases were at stage 4.

Also the method of Guhl[11] was used for the arthroscopic classification ; intact articular surface as stage 1, early separative lesion as stage 2, a partially detached lesion as stage 3, and a crater or loose body as stage 4. In our study, early separated stage 2 and partially detached lesions stage 3 were most common (12 cases) (Table 1).

Results

The results were analyzed by the criteria of Hughston et al[12] which including clinical and radiological outcomes (Table 2).

At the time of arthroscopic evaluation and treatment, the patients were classified into 4 different

Table 1 Arthroscopic findings and treatment methods

Arthroscopic findings	Treatment method	No. of cases	Results*
Group 1- Intact lesion	No specific procedure	4	3
Group 2- Early separation	Multiple drilling	4	3
Group 3- Partially detached lesion	Herbert screw fixation	8	7
Group 4- Crater +/- loose body	Loose body removal and crater	3	1
Total		19	14

* Number of good or excellent.

groups, using the following system : Group 1- stable lesion and no specific treatment after arthroscopic examination ; Group 2- early separation and multiple drilling ; Group 3- unstable lesion and Herbert screw fixation ; and Group 4- loose body removal or crater curettage. The study group consisted of four cases in Group 1, four cases in Group 2, eight cases in Group 3, and three cases in Group 4 (Table 1).

We analyzed the statistical difference using Z-test ($P < 0.05$).

There were 14 cases (74 %) with good or excellent results, in overall 19 knees as follows : 75 %(3/4) in the conservative treatment Group 1, 75 % (3/4) in the multiple drilling Group 2, 86 % (7/8) in the Herbert screw fixation Group 3, and 33 % (1/3) in the crater curettage or loose body removal Group 4. Herbert screw fixation Group 3 showed better results than other groups, with statistically significant differences (each $P < 0.05$) (Table 1).

Table 2 Rating criteria according to Hughston et al[12]

Rating	Criteria
Excellent	No limitation in activity ; No symptoms ; Examination normal ; Radiographs normal
Good	Mild aching on strenuous activity ; Examination normal ; Radiographs show healed defect or residual sclerosis
Fair	Mild aching and swelling on strenuous activity ; Examination normal ; Radiographs show flattening of the condyle but normal joint space
Poor	Pain & swelling on mild activity ; Tenderness ; Loss of 20 degrees of motion
Failure	Pain & swelling on no activity ; Tenderness ; Loss of motion of more than 20 degrees ; More than 2.5 cm of thigh atrophy ; Radiographs show absent joint space

Discussion

Many hypotheses have been proposed for the etiology of osteochondritis dissecans —including trauma, ischemia, abnormal epiphyseal center, genetic and endocrine causes. Many authors have suggested that endogenous and exogenous trauma resulted in stresses in the femoral condyle, and reported a high proportion of traumatic episodes in osteochondritis dissecans patients. In our study, 26 % of patients had a definite trauma history during sports activities, and the others had mostly minor trauma history.

Aichroth[13] reported that 80-85 % of osteochondritis dissecans lesions occurred in the medial femoral condyle, and our study also showed 74 % with medial femoral condyle involvement.

Historically, various methods including conservative therapy, curettage of the crater, multiple drilling, bone graft, loose body removal and fixation have been suggested for the treatment of osteochondritis dissecans[3~8]. Recently, osteochondral autograft[14] and autologous chondrocyte implantation (ACI)[15] have also been introduced.

The treatment of osteochondritis dissecans is

Fig. 1 A : Simple X-ray of a 13-year-old boy shows a nearly-detached osteochondral lesion in the medial femoral condyle.
B : MRI also shows a large osteochondral lesion surrounded by synovial fluid in the medial femoral condyle.
C : The lesion was treated by arthroscopic fixation using 3 Herbert screws, and the 12-months follow-up X-ray shows good healing of the lesion with excellent result.

dependent on the following variables ; age of the patient, size of the fragment, location of the lesion, stability of the lesion, radiological and arthroscopic findings. Over the past several years, arthroscopy has greatly enhanced the ability to diagnose and treat osteochondritis dissecans, and arthroscopic findings which by showing the correct size and stability of the lesion have been the most reliable guidance for deciding the method of treatment. Also, we have achieved satisfactory results in the treatment of osteochondritis dissecans using several treatment methods regarding the arthroscopic findings.

In the decision to use the fixation method for osteochondritis dissecans, various methods have been advocated, but use of metallic screw, Herbert screw, bioabsorbable screw, K-wire and bone pegs fixation remain controversial. Some authors have reported good healing of such lesions with these techniques, but others have noted a foreign body reaction, synovitis and unstable fixation as complications[6]. Wu et al[7] advocated Herbert screw fixation and reported good results from this technique. In our study, the results from Herbert screw fixation was better than those from other treatment methods, with statistically significant differences, with 86 % showing good or excellent results in this group (Fig. 1).

In our experience, even an unstable and large lesion under arthroscopic findings tended to have excellent results with the active fixation method, especially in young patients. But in the case of a large full thickness osteochondral defect in the weight-bearing surface, only crater curettage and multiple drilling had poor outcomes, and we have to consider other methods such as osteochondral autograft[14] and autologous chondrocyte implantation (ACI)[15] to improve the treatment.

Conclusion

In the treatment of osteochondritis dissecans in the femoral condyle, arthroscopic findings were a reliable guidance for deciding the treatment method. Active reconstruction including Herbert screw fixation technique is recommended in skeletally immature patients with a large unstable lesion.

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第5回日韓整形外科スポーツ医学会発表論文

Arthroscopic Ankle Arthrodesis

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● Key words
Ankle : Arthroscopy : Arthrodesis

● Abstract

Purposes : To analyze the results from arthroscopic ankle arthrodesis and to verify the advantages of the technique compared to open ankle arthrodesis.

Materials and Methods : Between October 1992 and August 1996, arthroscopic ankle arthrodesis was performed on five patients (involving six ankle joints) ; two patients with seropositive rheumatoid arthritis (one patient surgically treated bilaterally), two with osteoarthritis and one with tuberculous arthritis. There were one man and four women. Their average age was 48 years, ranging from 38 to 65 years. The follow-up period was an average of 45 months (range 12-80 months).

Results : All patients were successfully treated for ankle joint arthrodesis under arthroscopic control. The mean time to fusion was 10 weeks (range 6-15 weeks). There was a 100 % fusion rate with no complication.

Conclusion : Arthroscopic ankle arthrodesis was successful in all cases with less morbidity and shorter hospital stay, compared to open ankle arthrodesis. It was technically feasible with excellent predictability.

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Introduction

Ankle arthrodesis is an accepted treatment for patients with advanced and disabling tibiotalar arthritis or osteoarthritis. Albert[1] presented the first report of ankle arthrodesis in 1879. Since then, tibiotalar arthrodesis has been found to be a reliable intervention that relieves intractable pain caused by ankle joint degeneration. More than 30 techniques for obtaining ankle fusion have been described. As modern arthroscopic techniques have been adapted to the ankle joint, complicated ankle problems have become amenable to arthroscopic intervention. Several recent studies have reported successful results of arthroscopic ankle arthrodesis. This arthroscopic technique has provided several advantages over open fusion methods, including a shorter fusion time, excellent fusion rates, lower morbidity, and more rapid postoperative mobilization[2~6]. The purposes of this study were to analyze the results from arthroscopic ankle arthrodesis and to verify the advantages of the technique compared to open ankle arthrodesis.

Materials and Methods

1. Materials

Between October 1992 and August 1996, six operations of arthroscopic ankle arthrodesis were performed in five patients by one surgeon at the Kyung Hee University Hospital. We have retrospectively reviewed these six cases of arthroscopic ankle arthrodesis. Two patients had seropositive rheumatoid arthritis (one patient surgically treated bilaterally), two patients had osteoarthritis, and the other had tuberculous arthritis. There were one man and four women. The average age of the patients was 48 years, ranging from 38 to 65 years. The follow-up period was an average of 45 months, ranging from 12 to 80 months. All patients were reviewed to determine the time to fusion, fusion rate, postoperative complications, and the functional result.

2. Surgical technique

The arthroscopic procedure was performed under general anesthesia with the patient in the supine position in a manner that would facilitate fluoroscopic imaging and internal fixation. It was facilitated by distracting using a lateral based external fixator. The amount and force of distraction required for visualization was approximately 40 ~ 50 pounds (18 ~ 23 kg). Three portals were used : an anterolateral, an anteromedial and an anterocentral portal. The arthroscopic equipment necessary to perform this procedure included a 30° foreoblique 4 mm arthroscope with camera, appropriate video equipment, and an image intensifier. Also, curettes, high-speed motorized suction abraders (burr) and shavers, and large-diameter (6.5 mm) cannulated cancellous screws were needed.

Standard anterolateral and anteromedial arthroscopic portals were established. Initial debridement of hypertrophic synovium and of any loose osteochondral fragments was performed to adequately visualize the joint. The third anterocentral portal was then established for fluid outflow and instrumentation. Next, the articular surfaces of the tibial plafond, talar dome, and medial and lateral talomalleolar surfaces (medial and lateral gutters) were debrided of all remaining hyaline cartilage and subchondral bone. This step was performed using a motorized arthroscopic abrader (burr). During the debridement, care was taken to maintain the normal bony contour of the talar dome and tibial plafond. A small motorized burr was then used to remove a thin layer of subchondral bone to the level of viable bone with punctuated bleeding. It was not necessary to debride to cancellous bone.

In patients who had a large anterior lip osteophyte on the tibia or talus that blocked dorsiflexion of the talus to neutral, we removed it. Once viable cancellous bone was visualized on all surfaces of the talus and tibia, the ankle joint was secured with two

crossed cannulated screws. Percutaneously, one guide pin was drilled from the medial malleolus, beginning above the joint line and directed anteriorly into the neck of the talus. The other guide pin was initiated in the lateral malleolus, proximal to the joint line and directed slightly posteriorly into the dome of the talus. Next, all arthroscopic equipment was removed from the joint, the distraction was released, and the joint surfaces were reduced. The talus was held in the position of fusion. The foot was positioned in neutral flexion to slightly plantar flexion, with 0 to 5° of valgus of hindfoot angulation and approximately 5° of external rotation. With the ankle carefully held in the proper position, the guide pins were drilled into the talus. After reduction, placement of a guide pin was then checked by image intensification. The tibiotalar joint was stabilized with internal fixation using two or three 6.5 mm cannulated screws. The screw length was determined and the proper screws were inserted over the guide pins, and then screwed into place. Care was taken not to penetrate the subtalar joint with these screws. Confirmation of the reduction and screw placement was then made using permanent X-rays. The wounds were closed and the patient was placed in a short leg cast.

Cases

Case 1 : A 43-year-old woman suffering from degenerative osteoarthritis with severe arthritic changes in the right ankle joint was operated on arthroscopically with ankle joint arthrodesis using two cannulated screws. At six weeks postoperatively, radiographs showed bony union. At seven years postoperatively, she had slight discomfort after long-distance walking but no significant complication. Radiographs showed the appearance of osseous trabeculae crossing the ankle joint (Fig. 1).

Case 2 : A 40-year-old woman with tuberculous arthritis in the left ankle joint was operated on arthroscopically with ankle joint arthrodesis using two cannulated screws. Preoperative radiographs showed joint space narrowing and subchondral bone destruction. At eight weeks postoperatively, radiographs showed bony union. Radiographs obtained at two years postoperatively, showed fusion of the ankle joint without recurrence of infection (Fig. 2).

Results

All patients were successfully treated for ankle joint arthrodesis under arthroscopic control. Radiographically the average time to fusion was 10 weeks (range 6-15 weeks). There was a 100 % fusion rate, with no complication. All patients were satisfied with the outcome of the operation.

Discussion

Ankle arthrodesis is an accepted treatment for patients with advanced and disabling tibiotalar arthritis or osteoarthritis. Albert[1] presented the first report of an ankle arthrodesis in 1879. Since then tibiotalar arthrodesis has been found to be a reliable intervention that relieves intractable pain caused by ankle joint degeneration. More than 30 techniques for obtaining ankle fusion have been described[1~3,5,7~13]. A painful ankle can result from trauma, degenerative arthritis, rheumatoid arthritis, avascular necrosis in the talus, or posttraumatic dislocation and fracture. In our studies, two patients had seropositive rheumatoid arthritis (one patient surgically treated bilaterally), two patients had osteoarthritis, and the other had tuberculous arthritis.

Open fusion techniques vary, and alternatives include the following ; external fixation by Charnley[7] in 1951, onlay fibular grafts by Wang et al[13] in 1974, internal fixation with screws, staples, nails, Steinmann pins, and a variety of different plates by Morgan[9], Ross[10], Scranton[11] in 1985, and sliding anterior tibial grafts by Moeckel et al[8] in 1991.

Most open procedures require extensile incisions with soft tissue stripping, and many recommend

Fig. 1 A : Preoperative roentgenogram shows osteoarthritis in the right ankle.
B : Radiographic union occurred at 6 weeks postoperatively.
C : At 7 years postoperatively, an X-ray film shows the appearance of the osseous trabeculae crossing the ankle joint.

extensive bony resection with malleolar osteotomy, which destroys the normal tibiotalar relationship. Johnson et al[14] reviewed 140 ankle arthrodeses in 1968, finding a pseudoarthrosis rate of 11 % and an amputation rate of 3 %. Charnley[7] reported fibrous union in four of the first 19 compression arthrodeses in 1951, and Hallock et al[15] reported fibrous union in 23 % of 38 inlay-graft arthrodeses. Also 78 ankle fusions, performed between 1975 and 1990, were reviewed by Frey et al[16] in 1994. The overall complication rate was 56 %, including delayed union (12 %), nonunion (41 %), infection (3 %), nerve injury (3 %), malunion (3 %), and wound problems (3 %). However, a 1985 study by Morgan et al[9] reported a 95 % fusion rate and few complications in the long-term results from 101 ankle arthrodeses. Morgan's fusion technique maintained the bony contour of the ankle mortise and used two crossed transmalleolar screws for internal fixation. The rate of pseudoarthrosis was 5 %, four to five times less than in other recent large reports. Secure fusion was radiographically documented at 95 %, and the functional clinical result was good to excellent in 90 %. In 1994, Stranks et al[12] performed 20 open ankle arthrodesis with cross-screw fixation and achieved 19 solid bony unions. The average fusion time was 12.5 weeks,

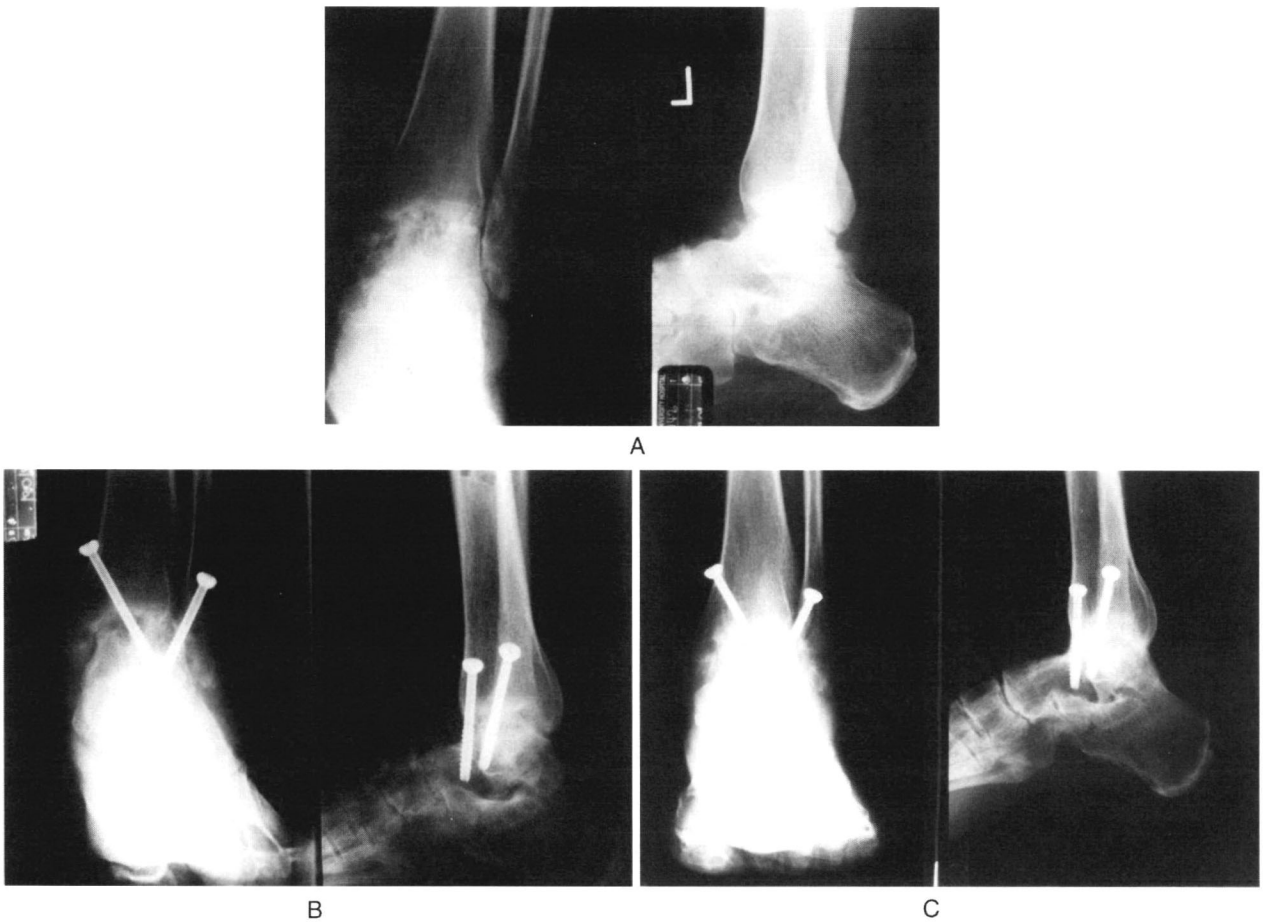

Fig. 2 A : The preoperative X−ray film shows subchondral destruction and joint space narrowing in the left ankle.
B : A roentgenogram obtained at 8 weeks postoperatively shows bony union.
C : At 2 years postoperatively, an X−ray film shows complete fusion of the ankle joint.

ranging from 9 to 19 weeks. Patient satisfaction was high, and the functional results were as good as for other reported methods, and with fewer complications.

As modern arthroscopic techniques have been adapted to the ankle joint, complicated ankle problems have become amenable to arthroscopic intervention. Several recent studies have reported successful results from arthroscopic ankle arthrodesis[2～6, 17]. The significant advantages of arthroscopic ankle arthrodesis are a shorter fusion time and excellent fusion rates. Ogilvie−Harris et al[5] reported 19 ankle fusions using an arthroscopic technique, with a 11 % nonunion rate, and an average fusion time of 10.5 weeks, in 1993. Turan et al[6], Corso et al[2], and Glick et al[3] reported an average time to fusion of 10 weeks, 9.5 weeks, and 9 weeks, respectively. These reports showed a faster fusion time following the arthroscopic method, compared with the open technique. Our results showed an average fusion time of 10 weeks, consistent with previous studies that reported a short fusion time. This more rapid union time in arthroscopic arthrodesis is due to maintaining the blood supply through the avoidance of extensive dissection and periosteal stripping. An excellent fusion rate of 94.1 to 100 % has also been reported[3, 4, 6] using the arthroscopic technique. In our studies, the arthroscopic ankle arthrodesis was successful in all

cases with no complication. Recently, Cameron et al[18] reported 15 arthrodesis cases in the ankle joint performed by arthroscopy. 100 % of the ankle joints achieved fusion at an average of 11.5 weeks.

Other advantages of arthroscopic ankle fusion are significantly less morbidity, shorter operative time, shorter tourniquet time, less blood loss, and a shortened hospitalization and recovery time. Small incisions and less soft tissue dissection make arthroscopic arthrodesis advantageous in patients with vascular, dermatological, diabetic, autoimmune, and other medical conditions that may contraindicate a surgical procedure with soft tissue disruption. But, some authors have reported a high complication rate after arthroscopic ankle arthrodesis. Crosby et al[19] reported a series of 42 cases using an arthroscopic technique in 1996. The overall complication rate was 55 %, including three of nonunion (7 %), two of fracture (4.8 %), four of pin site infection (9.5 %), one of deep infection, four of hardware problems (9.5 %), and four of symptomatic painful subtalar joints (9.5 %). In our series, there was no evidence of any postoperative complications.

In 1991, Myerson et al[4] were the first to compare the outcome results between open and arthroscopically fused ankle joints. Arthroscopic arthrodesis was performed in 17 patients, using open arthrotomy and malleolar ostectomy in 16. The mean time to arthrodesis for patients having the procedure arthroscopically was 8.7 weeks (range from 6 to 14 weeks), compared to 14.5 weeks in the open arthrotomy group (range from 8 to 26 weeks). O'Brien et al[17] reported the results from 36 patients who underwent ankle arthrodesis, in 1999. Nineteen patients underwent arthroscopic ankle arthrodesis, and 17 patients underwent open arthrodesis. Arthroscopic ankle arthrodesis yielded comparable fusion rates to open ankle arthrodesis, with significantly less morbidity, shorter operative time, shorter tourniquet time, less blood loss, and shorter hospital stay. Arthroscopic ankle arthrodesis is a valid alternative to traditional open arthrodesis of the ankle for selected patients with ankle arthritis.

This arthroscopic technique provided several advantages over open fusion methods, but Glick et al[3] performed 34 ankle fusions using an arthroscopic technique and reported that there were some disadvantages in arthroscopic ankle fusion. The procedure may take longer to perform because of the longer time needed to set up the arthroscopy equipment and of the somewhat laborious task of arthroscopic burring. Another disadvantage is that the arthroscopic technique cannot address significant angulatory or translational deformities in the tibio-talar joint. More than 10 to 15° of varus or valgus malalignment requires extensive arthroscopic burring and reshaping of the joint surfaces, which is too difficult to achieve arthroscopically. Similarly, more than 10 mm of anterior or posterior translation of the tibio-talar joint is difficult to correct because of the limited soft tissue dissection performed during the procedure. Patients with significant malalignment in the ankle should be considered for open rather than arthroscopic fusion.

Conclusion

Arthroscopic ankle arthrodesis was successful in all cases with less morbidity and shorter hospital stay compared to open ankle arthrodesis. There was a 100 % fusion rate, and an average fusion time of 10 weeks with no complication. It was technically feasible, with excellent predictability. Arthroscopic ankle arthrodesis is a valid alternative to traditional open arthrodesis of the ankle for selected patients with ankle arthritis.

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第5回日韓整形外科スポーツ医学会発表論文—GOTS Traveling Fellow—

Ankle Ligament Lesions in 123 Amateur Athletes : A Comparative Study of Semifunctional vs. Surgical Treatment

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● Key words
Lateral ankle ligament lesions : Malleocast® : Ankle orthoses : Functional treatment

● Abstract
Ligament lesions in the ankle joint are one of the most frequent traumatic injuries in the locomotor system. In the same way as a top athlete must return to sport activities, the ordinary patient must return to work. The amateur athlete wants to go back to sports activities as early as possible, too. This requires fast and sufficient healing of this lesion. In this article the semifunctional therapy using the Malleocast® (Bauerfeind, Germany) orthoses is compared with surgical treatment in 123 patients after an average follow-up of 5 years. Nearly the same positive results can be achieved after either conservative or operative treatment. However the functional treatment offers the advantage of a significantly shorter rehabilitation. That allows the athlete to return to sports activities much earlier. This is of importance for psychological and physiological reasons as well as from a socio-economical point of view in workers.

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3) GOTS-Traveling Fellows Working Group 2000

Introduction

Lateral ankle ligament lesions are one of the most traumatic injuries in the locomotor system in athletes. In a three years follow-up 2,600 patient charts have been reviewed in the Department for Sports Injuries. 30 percent of the patients suffered from an ankle lesion. In two-thirds of the lateral ankle ligament lesions, a combined 2 ligament lesion was found. The damaged structure was : 1. the calcaneofibular ligament, responsible for an increasing talus tilt, or 2. the anterior talofibular ligament, which leads to a pathological talus translation. There is still dispute over the optimum therapy for these injuries. The present study set out to compare semifunctional treatment with surgical treatment. The semifunctional therapy was performed using the L-formed Malleocast® orthoses (Fig. 1), which is made of a semirigid, thermo-moldable material. The range of motion is less in comparison with the U-formed orthoses. The authors believe that this decreased range of motion is one of the advantages of L-formed orthoses. Thus various lesions, such as in the medial ankle ligaments or light drop foot, can be treated using this L-formed orthoses.

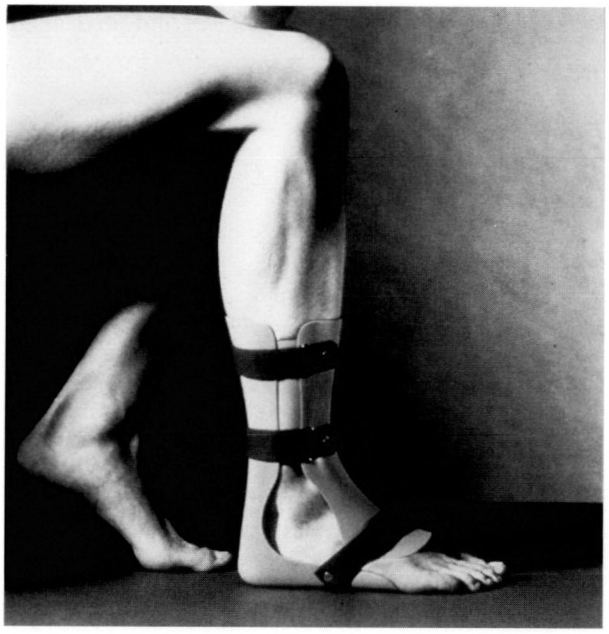

Fig. 1 Malleocast® (Bauerfeind, Germany).

Materials and Methods

The criteria for inclusion into this study were stress X-rays after injury with a talus translation under 1.5 cm and a talus tilt under 15°. It had to be the first injury. Cases with any additional lesion were excluded.

123 patients were included into this study. Treatment was performed between 1989 and 1992. The semifunctional therapy algorithm consisted of a split plaster until the swelling subsided. After subsidence, the Malleocast® orthoses was fitted by a technician, and worn for up to 6 weeks. The treatment was completed with different bandages consisting of pads, tapes and special shoes (Fig. 2).

In the patients of the surgical group, surgery was performed within 36 hours after injury. All these patients received a split plaster until wound healing. A walking plaster was applied for a duration of up to 6 weeks in total. In this group, the patients also received technical aids as described before (Fig. 2).

The following results were found with the help of the "Telos-Apparatus" according to Dr. Scheuba. All patients were clinically examined.

Fig. 2 Different bandages, orthoses and shoes for the first time following the described therapy.

Clinical Study

Between 1989 and 1992, 123 amateur athletes with an injury in the lateral ankle ligaments were treated in the Department for Sports Traumatology of the Hospital for Trauma Surgery Graz. 64 patients belonged to the semifunctional group, and 59 athletes received surgical treatment. The semifunctional group consisted of 43 male and 21 female athletes. 38 right and 26 left ankle joints were injured. The athletes were non-professional athletes, who had sports training more than three times during a week and who participated in competitions. After the injury, the patients received a split plaster. After the swelling subsided, the Malleocast® orthoses was applied by the orthotist. If the patient foot size was bigger than 43 cm an individual orthoses was applied. It is very important that the toes and the metatarsophalangeal joints stay free. Thus, a roll off with the orthoses is possible. The thermo moldable orthoses has to fit painfree and without points of pressure peaks. Additional velcros were fixed as necessary.

The patients were instructed by doctors, physiotherapists, and orthotists to wear the orthoses like plaster-of-Paris for 24 hours a day. Thus plantar flexion during the night time can be prevented if the patient likes to sleep on his belly. It should be pointed out that the advantage of an L-formed orthoses is not only the prevention of supination, but also helping prevent plantar flexion of more than 20°. It has been suggested in different studies that a plantar flexion over 20° leads to negative stress in the healing ligaments. This is the reason why the L-formed orthoses seems to show better results than the U-formed orthoses. The U-formed orthoses needs shoes for full effect. For reasons of hygiene, showers and baths should be taken while wearing the orthoses. Afterwards the patient has to sit down and dry the skin and orthoses very carefully. Thus mazeration of the skin and additional injury can be prevented.

The wearing of compression stockings under the Malleocast® helps to decrease the amount of swelling and increases the blood flow. If the patient is not willing to wear compression stockings, the authors recommended short cotton socks.

The average wearing time of the Malleocast orthoses was 25 days (from 19 to 39 days). Proprioceptive training was initiated during the last week of using the orthoses. Tapes, bandages and shoes were applied to help return the patients to work and to sports activities, as early as possible, and to prevent relapses. Technical aids were recommended according to the branch of athletics (2).

The surgical group consisted of 59 patients including 31 males and 28 females. 34 had injured the right, and 25 the left ankle. They underwent surgery within 36 hours after the injury. A split plaster was applied until wound healing. Afterwards, a walking cast, made from plaster-of-Paris, was applied. The average time of cast application was 28 days (from 24 to 39 days). At the time of injury, an average talus tilt of 12.7° (from 8 to 15°) was found in the semifunctional group, and of 13.2° (from 9 to 15°) in the surgical group. The talus translation in the Malleocast® group (semifunctional group) before treatment was 1.3 cm (from 0.7 to 1.5 cm) on average, and 1.1 cm (from 0.6 to 1.5 cm) in the operative group. The average age in each group was 26 years.

Results (Table 1)

After an average follow-up time of 5 years, the examination of the patients was done clinically and radiologically with stress X-rays using the Apparatus according to Dr. Scheuba. The semifunctional group showed an average talus tilt of 2.3° (from 0 to 5°) and the surgical group of 3° (from 0 to 7°). The average talus translation at 5 years after treatment in the semifunctional group was 0.2 cm (from 0 to 0.6 cm) and in the operative group was 0.3 cm (from 0 to 0.6 cm). Complications were found in both groups. 9 patients in the Malleocast® group had problems ; 4

Table 1

Results :	Malleocast® Group	Surgical Group
Talus tilt before :	12.7°	13.2°
Talus tilt after :	2.3°	3°
Talus translation before :	1.3 cm	1.1 cm
Talus translation after :	0.2 cm	0.3 cm
Back to specific sport :	47 days	60 days
Back to competition :	71 days	92 days

with swelling in the ankle and 5 with foot twisting. In the operative group, 14 patients had problems ; 6 patients suffered from foot twisting, 5 patients had trouble with the operative scars, especially when wearing shoes, where a shoe conflict arose at the shoe-rim, and 3 had problems with foot swelling.

No days of hospitalisation were necessary in the semifunctional group. The surgical group stayed on average 7.5 days in hospital (from 1 to 11 days).

The average days of recovery and back to training after the injury in the semifunctional group was 47 days (from 24 to 113 days), and in the surgical group was 60 days (from 31 to 109 days).

After an average of 71 days (from 39 to 156 days) after injury, patients from the Malleocast® group could participate in competitive sports. 2 patients cancelled competitions. In the surgical group, there was an average of 92 days (from 39 to 167 days) of recovery, before the patients went back to competitions. 4 did not continue with competitions.

Discussion

First it has to be mentioned that this study was done on amateur athletes who are not so interested in going back to sports as full professionals might want. A professional athlete has to return to his work as fast as possible like a worker who is afraid of losing his job. Amateur athletes do not have this pressure. For sure an amateur wants to go back to his training as early as possible, but with different feelings and reasons. Thus the recovery time back to specific training and competition is much longer than in high-level professional athletes.

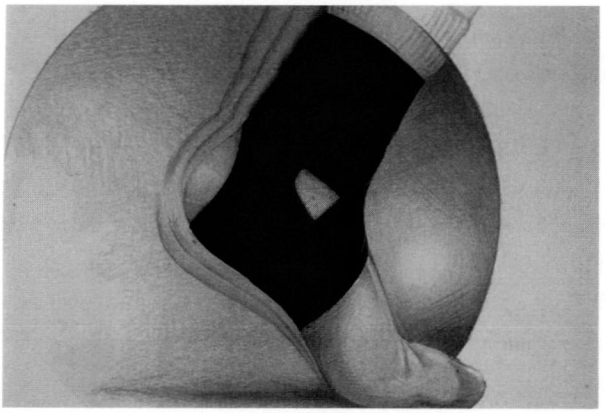

Fig. 3 Push Aequi® (Ofa Bamberg, Germany).

From the authors point of view, the kind of therapy algorithm is clearly defined. In the first line of treatment, functional therapy is preferred and recommended. Only the coexistence of other injuries like a flake fracture or a "three ligament lesion" is reason for surgical treatment in the first instance of a lateral ankle ligament injury. The most important factor in functional therapy is the patient's compliance. Without that, it is better to use plaster-of-Paris.

The authors like to use L-formed orthoses like the Malleocast®. This aid is made of semirigid material which the authors think is not necessary anymore. Thus they like to use newer, more comfortable orthoses like the Caligamed® (Bauerfeind, Germany) or DynaAnkle® (Otto Bock, Germany) or Push Aequi® (Ofa Bamberg, Germany) (Fig. 3). These products are less rigid and bulky and fit better into ready-made shoes or sneakers, but give the same safe support to the ankle joint. The functional treatment achieved the results similar to those from surgical therapy. Functional treatment was faster and more comfortable for the patient. (A similar study was done in 201 patients : the duration of working disability in the functional group was 20.6 days and in the surgical group 38 days) The functional treatment had less risk and has major advantages from a socio-economic point of view as well.

Japanese Journal of ORTHOPAEDIC SPORTS MEDICINE

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

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

本会の事務局は，理事会の議により定めた場所に置く

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個人
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，理事長が理事会および評議員会の議を経て推薦する者
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が，そこで発表した内容を機関誌に投稿する場合は共著者となることができる

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　10名以上15名以内（うち理事長1名，常任理事1名）

2）監　事　2名

第10条　役員の選出

1）理事および監事は，別に定めるところにより評議員の中から選出し，総会の承認を要する

2）理事長は，理事会において理事の互選により選出する

3）常任理事は理事長の指名により理事会において決定する

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，理事長を補佐するほか，事務局を統括し常務を処理する

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1期3年とし，再任は妨げない

但し，連続して2期6年を越えることはできない

第13条　評議員

1）本会には50名以上150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および準会員に限る

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

当分の間，本会の事務局は名古屋市天白区音聞山1013
有限会社ヒズ・ブレイン内に置く

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
本改正会則は，平成９年５月17日から施行する
本改正会則は，平成10年９月12日から施行する
本改正会則は，平成12年５月20日から施行する

日本整形外科スポーツ医学会
入会資格および年会費に関する細則

第1条　日本整形外科スポーツ医学会会則第6条ならびに第18条によりこの細則を定める

（入会資格および手続き）

第2条　正会員になろうとする者は，下記の事項を具備することを要する
1）日本国の医籍登録番号を有すること
2）所定の入会申込書に所要事項を記載し，署名して学会事務局へ提出すること
3）評議員1名の推薦を得ること

第3条　準会員になろうとする者は，下記の事項を具備することを要する
1）所定の入会申込書に所要事項を記載し，署名して学会事務局へ提出すること
2）評議員2名の推薦を得ること

第4条　賛助会員になろうとする者は，下記の事項を具備することを要する
1）所定の入会申込書に所要事項を記載し，署名押印して学会事務局へ提出すること
2）評議員2名の推薦を得ること

（入会の承認）

第5条　第2条，第3条ならびに第4条による所定の手続きを行なったものは，理事会の審議を経て入会の可否が決定される

（会費の納入）

第6条　入会の許可を受けた者は直ちに当該年度の年会費を納入しなければならない

第7条　年会費は，下記の通りとする
正会員：12,000円，準会員：6,000円，賛助会員：50,000円以上

第8条　会費は，当該年度に全額を納入しなければならない

（会員の権利および義務）

第9条　正会員は下記の権利および義務を有する
（権利）
1）本学会が刊行する機関誌および図書等の優先的頒布を受けること
2）総会，学術集会，その他本学会が行なう事業への参加ができること
3）機関誌への投稿，および学術集会への出題・応募ができること
4）その他本学会の会則および細則に定められた事項
（義務）
1）会費を納入すること
2）総会の議決を尊重すること
3）住所，氏名，学会機関誌送付先等に変更のある場合は速やかに事務局へ届出ること

第10条　準会員は下記の権利および義務を有する

（権利）

1）本学会が刊行する機関誌および図書等の優先的頒布を受けること

2）総会，学術集会への参加ができること

3）機関誌への投稿，および学術集会への出題・応募ができること

4）準会員は役員・評議員等の選挙権および被選挙権を有しない

（義務）

1）会費を納入すること

2）総会の議決を尊重すること

3）住所，氏名，学会機関誌送付先等に変更のある場合は速やかに事務局へ届出ること

第11条　賛助会員は下記の権利および義務を有する

（権利）

1）本学会が刊行する機関誌および図書等の優先的頒布を受けること

2）学術集会への参加ができること

3）賛助会員は総会での議決権，役員・評議員等の選挙権および被選挙権を有しない

（義務）

1）会費を納入すること

2）総会の議決を尊重すること

3）住所，氏名，学会機関誌送付先等に変更のある場合は速やかに事務局へ届出ること

附　則　1　この細則の変更は理事会で行ない，評議員会，総会の承認を要する

2　この細則は平成12年5月20日から施行する

評議員選出に関する細則

（総　則）

第１条　　日本整形外科スポーツ医学会会則第13条２による評議員の選出はこの定めによる

（評議員の定数，任期）

第２条　　評議員の定数は150名以内とする

　　２　　評議員の任期は３年とする
　　再任は妨げないが，70歳を超えないものとする

（新評議員の選考および委嘱）

第３条　　理事長は，理事会が必要と認めたとき，推薦方法を明示し新評議員の推薦を受ける

　　２　　新評議員の被推薦資格は，原則として入会後10年以上を経過した正会員が，これを有する

　　３　　新評議員の推薦資格は，評議員がこれを有する
　　新評議員を推薦しようとする者は，定められた日時までに所定の推薦状を理事長に提出しなければならない

　　４　　新評議員の選考は，理事会で行ない，評議員会に報告する

　　５　　新評議員は，理事長がこれを委嘱する

附　則　　１　本細則の変更は理事会で行ない，評議員会，総会の承認を要する

　　２　本細則は平成12年５月20日から施行する

役員選出に関する細則

（総　則）

第１条　日本整形外科スポーツ医学会会則第10条による役員の選出はこの定めによる

第２条　役員の選出は，評議員会において行う

（選挙権および被選挙権）

第３条　選挙権は評議員がこれを有する

第４条　役員の被選挙権は，本会評議員のうち，就任の年の４月１日現在年齢満67歳未満の者に限りこれを有する

第５条　理事および監事の任期は３年とする
再任は可能であるが連続６年は超えない

（改選数）

第６条　理事長は，選挙の行なわれる前年の12月31日までに，改選数を公示する
ただし，改選数は会則第９条の規定による

（立候補および推薦状の届出）

第７条　役員に立候補しようとする者，または役員を推薦しようとする者は，選挙の行なわれる年の１月31日までに本人の立候補届，または被推薦者の同意書とともに評議員３名以上の推薦状を理事長に提出しなければならない

（選挙立会人）

第８条　評議員会議長は，選挙当日の出席評議員の中から選挙立会人若干名を指名する

（投　票）

第９条　投票は無記名とし，理事については予告された改選数の半数の完全連記とする
ただし，定数が奇数のときは切り上げるものとする

２　監事選挙については完全連記とする

（当選者の決定）

第10条　有効投票数の多数を得たものを当選者とする

２　得票が同数で選出できない場合には，その候補者について再度投票を行う

３　当選者は総会の承認を受けなければならない

（投票の効力）

第11条　投票の効力は選挙立会人の意見を聞きこれを決定しなければならない

第12条　次の投票はこれを無効とする

1）評議員会議長が準備した用紙を用いないもの
2）候補者の氏名を確認しがたいもの
3）同一氏名を重複して記載したもの
4）候補者以外の氏名を記載したもの
5）定数を超えて記載したもの

附　則　１　本細則の変更は理事会で行ない，評議員会，総会の承認を要する

２　本細則は平成12年５月20日から施行する

委員会委員に関する内規

1. 日本整形外科スポーツ医学会会則第14条2による委員会委員についてはこの定めによる
2. 委員は原則として評議員の中から理事長が委嘱する
3. 委員の任期は3年とするが，理事会が認めれば再任することができる
4. 委員長は，委員の互選によって決定する
5. 委員の交代に当たり，退任する委員は自分の後任として3名の候補者を理事長に推薦する
6. 理事長は新委員の選任に当たり，前項の委員候補者リストを参考とし，広く総意を求めるため，職務，地域等に留意し，委員の重複がないように選定して委嘱する

附　記

1　本内規の変更は理事会において行う
2　本内規は平成12年5月20日から施行する

名誉会員に関する内規

日本整形外科スポーツ医学会会則第5条4による名誉会員の推薦についてはこの定めによる

① 日本整形外科スポーツ医学会理事，監事経験者
② 日本整形外科スポーツ医学会学術集会会長経験者
③ 上記に準ずる功労のあった者
④ ①②③のいずれかに該当する者が，年齢が70歳に達した場合，あるいは職を定年により退いた場合
但し，本会の役員の任にある者は，その任を終えた場合

附　記

1　本内規の変更は理事会において行う
2　本内規は平成12年5月20日から施行する

名誉会員・特別会員

青木　虎吉　　高岸　直人　　渡辺　好博
赤松　功也　　津山　直一　　Bernard R. Cahill
東　博彦　　鞆田　幸徳　　Wolf-Dieter Montag
今井　望　　鳥山　貞宣　　W. Pforringer
榊田喜三郎　　林　浩一郎　　George A. Snook
鈴木　良平　　茂手木三男

理　事

◎井形　高明　　越智　隆弘　　富田　勝郎　　圓尾　宗司
生田　義和　　黒澤　尚　　中嶋　寛之　　武藤　芳照
○石井　清一　　田島　直也　　原田　征行　　守屋　秀繁

◎理事長　○常任理事

監　事

霜　礼次郎　　藤巻　悦夫

評議員

青木　治人　　菊地　臣一　　菅原　誠　　成田　寛志　　松井　宣夫
阿曽沼　要　　城所　靖郎　　杉田　健彦　　仁賀　定雄　　松崎　昭夫
阿部　正隆　　木村　雅史　　勝呂　徹　　丹羽　滋郎　　松本　学
天野　正文　　栗山　節郎　　高尾　良英　　乗松　敏晴　　三木　英之
有馬　亨　　黒坂　昌弘　　高木　克公　　乗松　尋道　　宮川　俊平
伊藤　恵康　　古賀　良生　　高岸　憲二　　初山　泰弘　　宮永　豊
井上　一　　腰野　富久　　高倉　義典　　濱　弘道　　村上　元庸
今井　立史　　小山　由喜　　高良　宏明　　浜田　良機　　森　雄二郎
今給黎篤弘　　斎藤　明義　　瀧川宗一郎　　平澤　泰介　　安田　和則
入江　一憲　　斎藤　知行　　竹下　満　　廣橋　賢次　　矢部　裕
岩本　英明　　左海　伸夫　　竹田　毅　　福田　眞輔　　山賀　寛
上崎　典雄　　酒井　宏哉　　田島　寶　　福田　宏明　　山本　博司
内田　淳正　　阪本　桂造　　立花　陽明　　福林　徹　　山本　龍二
内山　英司　　桜庭　景植　　田中　寿一　　冨士川恭輔　　横江　清司
大久保　衛　　佐々木良介　　田渕　健一　　藤澤　幸三　　吉田　宗人
大槻　伸吾　　佐藤　光三　　土屋　明弘　　古府　照男　　吉松　俊一
岡崎　壮之　　史野　根生　　土屋　正光　　別府　諸兄　　米延　策雄
岡村　良久　　柴田　大法　　戸松　泰介　　星川　吉光　　龍　順之助
越智　光夫　　下條　仁士　　冨永　積生　　堀川　哲男　　若野　紘一
柏口　新二　　白井　康正　　中山　義人　　本庄　宏司　　和田　佑一
加藤　哲也　　須川　勲　　成田　哲也　　増島　篤　　渡會　公治

（敬称略）

学術集会について

第28回日本整形外科スポーツ医学会学術集会
第6回日韓整形外科スポーツ医学合同会議（併催）

会　期：2002年3月27日（水）・28日（木）・29日（金）
会　場：高知新阪急ホテル
〒780-0870　高知市本町4-2-50
TEL 088-873-1111

お問合せ先：〒738-8505　南国市岡豊町小蓮
高知医科大学整形外科学教室内
第28回日本整形外科スポーツ医学会学術集会事務局
TEL 088-880-2386 / FAX 088-880-2388
e-mail : seikei@kochi-ms.ac.jp

第28回日本整形外科スポーツ医学会学術集会
会長　山本　博司
（高知医科大学整形外科学教室）

学会開催のお知らせ

第15回東日本手の外科研究会

第15回東日本手の外科研究会を下記要領にて開催いたしますので，
多数のご参加をお願い申し上げます。

会　期：2001年2月3日(土)
会　場：シェーンバッハ・サボー
〒102-0093　東京都千代田区平河町2-7-5

プログラム：＜特別講演＞

＊Steven F. Viegas, M.D.
(Prof. & Chief, Division of Hand Surgery,
University of Texas Medical Branch)

＊Warren Breidenbach, M.D.
(Louisville Hand Surgery, University of Louisville)

＜主　題＞

Ⅰ. 診断治療の新しい試み
Ⅱ. 手の外科のバイオメカニクス
Ⅲ. 手の外科の同種移植の現状（演者指定）

●演題募集は終了しました。

問合せ先：〒468-0063　名古屋市天白区音聞山1013
有限会社ヒズ・ブレイン内
第15回東日本手の外科研究会 登録事務局
TEL 052-836-3511 / FAX 052-836-3510
E-mail hisbrain@now.or.jp

第15回東日本手の外科研究会
会長　別府　諸兄
(聖マリアンナ医科大学整形外科学教室)

第14回日本創外固定・骨延長学会

会　期：2001年2月16日(金)・17日(土)
会　場：東京大学　安田講堂および山上会館
東京都文京区本郷7-3-1　東京大学構内

特別講演：1. The Management of Unstable Distal Radius Fractures
Margaret M. McQueen (Royal Infirmary of Edinburgh, U.K.)
2. Biomechanics of External Fixation (仮題)
Stephan M. Perren (The AO Development, Switzerland)

パネルディスカッション(指定演者)
1.「創外固定を用いた橈骨遠位端骨折の治療」
2.「成人の下腿変形の矯正」
治療の現状について学会での調査の結果を報告する予定です。

主題：1. 創外固定のバイオメカニクス
2. 創外固定を用いた外傷の治療
招待講演の演者を交え討論したいと考えています。
3. ビデオ演題—創外固定の創意工夫
4. 変形矯正
5. 骨折および骨延長の基礎

●演題募集は終了しました。

連絡先：〒113-0033　東京都文京区本郷7-3-1
東京大学医学部整形外科学教室　大西五三男
TEL 03-3815-5411 (内33376) / FAX 03-3818-4082
E-mail OHNISHII-DIS@h.u-tokyo.ac.jp

第14回日本創外固定・骨延長学会
会長　中村　耕三
(東京大学医学部整形外科学教室)

第11回関西臨床スポーツ医・科学研究会

会　期：2001年6月16日(土)
会　場：薬業年金会館
(地下鉄谷町線及び長堀鶴見緑地線「谷町6丁目」下車)
TEL 06-6768-4451

教育講演：藤井　暁(大阪市立総合医療センター院長)
『21世紀のスポーツ医科学』
―生活習慣病の運動療法の現状と展望について―
＊日整会教育研修・スポーツ研修1単位申請中
日医健康スポーツ医教育研修申請予定

シンポジウム：多機能臓器としての筋肉と運動

演題募集：演題内容　スポーツ傷害・スポーツリハビリテーション
応募方法　演題名，所属機関，専門科名，氏名(演者に○印)を明記し，
下記へ抄録用紙をご請求ください。
(演題の採否は幹事会にご一任ください)

抄録申込締切：2001年2月28日(水)

演題締切：2001年3月31日(土)

会　費：6,000円(当日参加費3,000円，年会費3,000円)

申込先：〒558-8585　大阪市住吉区杉本3-3-138
大阪市立大学保健体育科
藤本繁夫
TEL 06-6605-2953 / FAX 06-6605-2953

事務局：〒634-8522　奈良県橿原市四条町840
奈良県立医科大学整形外科学教室内
関西臨床スポーツ医・科学研究会事務局
TEL 0744-22-3051 / FAX 0744-25-6449

第11回関西臨床スポーツ医・科学研究会
会長　藤本　繁夫
(大阪市立大学保健体育科)

第19回関節鏡セミナー

会　期：2001年8月3日(金)・4日(土)
会　場：函館大沼プリンスホテル
〒041-1392　北海道亀田郡七飯町西大沼
TEL 0138-67-1111
定　員：150名（定員になり次第，締め切らせていただきます）
参加費：28,000円（宿泊費別）

申込要領：初心者・経験者のコースに分けてワークショップを行う予定です。参加ご希望の方は，官製はがきに「関節鏡セミナー申し込み」と明記し，所属，氏名(ふりがな)，連絡先住所・電話番号をご記入のうえ，下記連絡先までお申し込みください。折り返し申し込み票を郵送いたします。
なお，日本関節鏡学会会員の方には，「関節鏡 vol.25, No.2」に申し込み票が綴じ込まれる予定です。

事務局：〒060-8638　札幌市北区北15条西7丁目
北海道大学大学院医学研究科外科治療学講座生体医工学分野内
第19回関節鏡セミナー事務局（担当：遠山晴一）
TEL 011-706-7211 / FAX 011-706-7822

第27回日本関節鏡学会
会長　安田　和則
（北海道大学外科治療学講座生体医工学分野）

第28回日本肩関節学会

会　期：2001年9月15日(土)・16日(日)
会　場：パシフィコ横浜
横浜市西区みなとみらい1-1-1
TEL 045-221-2155

招待講演：(教育研修講演)

○ "The throwing shoulder"
Frank W. Jobe, M.D. (Clinical Professor, University of Southern California, U.S.A.)

○ "Rotator cuff repair, a clinical and basic science challenge"
Roger Emery, MS FRCS (Consultant Orthopaedic Surgeon, St. Mary's Hospital, U.K.)

演題募集：1) 主題

I. 腱板広範囲断裂の治療
II. 反復性肩関節前方脱臼の長期成績 (5年以上)
III. スポーツ肩障害の病態と治療
IV. 人工骨頭・人工関節置換術の適応と成績
V. 肩関節疾患に関する基礎的研究
VI. 診断・治療に難渋した症例の検討

2) 一般演題

演題締切：**1次締切：2001年1月31日必着**
官製はがきに主題・一般演題の区分，演題名，発表者名，所属，住所，TEL，FAX番号をご記入のうえ，下記事務局までお申込みください。折り返し抄録用紙をお送りいたします。

2次締切：2001年3月31日必着

事務局：〒221-0052　横浜市神奈川区栄町5-1
(株)パシフィック・コンベンションサービス内
第28回日本肩関節学会事務局
担当：和田，菊竹
TEL 045-441-8441 / FAX 045-441-8444

第28回日本肩関節学会
会長　森岡　健
(横浜市立市民病院)

第27回日本関節鏡学会

会　期：2001年9月21日(金)・22日(土)
会　場：北海道厚生年金会館（札幌市中央区北1条西12丁目）
　　ロイトン札幌（札幌市中央区北1条西11丁目）

演題募集：

1. **主題**

(1) 膝複合靱帯損傷の診断と治療
(診断と治療における現在の問題点を指摘する演題や，その改良・解決へ向けた種々の工夫に関する演題を広く募集します。必ずしも関節鏡の問題のみに限定しません。)

(2) 関節鏡・内視鏡下手術における手技・材料・器具の工夫
a) 膝半月板修復術
b) 手根管開放術
c) 種々の肩関節構成体に対する修復術
d) 脊椎脊髄手術
e) 顎関節手術
f) その他

2. **一般演題**
官製はがきに演題名，所属，演者名，連絡先，必要部数を明記のうえ，下記登録事務局まで抄録用紙をご請求ください。

演題1次締切：2001年3月30日(金)
演題2次締切：2001年5月25日(金)

登録事務局：〒060-0003　札幌市中央区北3条西4丁目　日本生命ビルB1
JTBコンベンション企画センター内
第27回日本関節鏡学会　登録事務局
TEL 011-221-4800 / FAX 011-232-5320

事務局：北海道大学外科治療学講座生体医工学分野内
第27回日本関節鏡学会事務局
担当：遠山晴一

第27回日本関節鏡学会
会長　安田　和則
(北海道大学外科治療学講座生体医工学分野)

第12回日本臨床スポーツ医学会学術集会

会　期：2001年11月3日(土・休日)・4日(日)
会　場：つくば国際会議場　エポカルつくば
〒305-0032　つくば市竹園2-20-3
TEL 0298-61-0001 / FAX 0298-31-1209
テーマ：時代とともに歩むスポーツ医学・医療

〈開催主旨〉

21世紀は情報化，高齢・少子化，国際化がよりいっそう進む。臨床スポーツ医学もこのような社会情勢の変化を視野においたアクションと貢献が期待される。そのためには，新しい科学や技術の導入はもとより，多職種にわたるスポーツ医療関係者，産業界，行政の緊密な協力も不可欠である。

2001年を迎えるにあたって，臨床スポーツ医学の意義と役割を踏まえて，さらに前進させながら，本学会を多様な社会的，医学的要請に応える機会とする。

演題募集：一般演題および症例報告を募集いたします。募集要項は日本臨床スポーツ医学会誌9巻1号に掲載されています。また下記ホームページでもご案内しております。今回よりインターネットでの申込み受付けのみとなります。

応募締切：2001年6月14日(木)

ホームページ：URL http://rinspo12@taiiku.tuskuba.ac.jp/ に学術集会案内・演題募集要項などを掲示しております。

学術集会事務局：〒305-8574　つくば市天王台1-1-1
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E-mail rinspo12@med.taiiku.tsukuba.ac.jp

第12回日本臨床スポーツ医学会学術集会
会長　宮永　豊
(筑波大学体育科学系スポーツ医学)

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