VIKTOR NELSON MAZZOLA CORRÊA

AVALIAÇÃO RADIOLÓGICA DA ACURÁCIA DA UTILIZAÇÃO DO PONTO C COMO INDICADOR PARA IDENTIFICAÇÃO DO TÚNEL FEMORAL NA RECONSTRUÇÃO ANATÔMICA DO LIGAMENTO CRUZADO ANTERIOR

Dissertação apresentada ao Curso de Pós- graduação da Faculdade de Ciências Médicas da Santa Casa de São Paulo para obtenção do Título de Mestre em Pesquisa em Cirurgia.

SÃO PAULO

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Área de Concentração: Pesquisa em Cirurgia

Orientador: Prof. Dr. Nilson Roberto Severino

Co-orientador: Prof. Dr. Ricardo de Paula Leite Cury

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1. Artroscopia 2. Ligamento cruzado anterior 3. Reconstrução do ligamento cruzado anterior

BC-FCMSCSP/43-25

DEDICATÓRIA

À minha mãe **Maria Amélia** e meu pai **Olavo**, que são meus pilares morais e meus maiores exemplos.

À minha noiva, **Denise Teles**, que me faz sempre querer ser melhor e compartilha meus sonhos.

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LISTA DE ABREVIATURAS

LCA – Ligamento cruzado anterior

RLCA – Reconstrução do ligamento cruzado anterior

AM – Anteromedial

mm – milímetros

IMC – Índice de massa corporal

TC 3D – Tomografia computadorizada com reconstrução tridimensional

ICC – *Intraclass correlation coefficient*

SEE – *Standard error of estimate*

SEM – *Standard error of measurement*

IKDC – *International Knee Documentation Committee*

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1 INTRODUÇÃO

Nas últimas décadas, as técnicas artroscópicas de reconstrução do ligamento cruzado anterior (RLCA) passaram por avanços significativos(1). Tradicionalmente, a abordagem mais utilizada era a técnica transtibial túnel dependente(1). No entanto, evidências na literatura demonstraram que essa técnica apresenta limitações importantes, sobretudo no que se refere à impossibilidade de posicionar adequadamente o túnel femoral na inserção anatômica do ligamento cruzado anterior (LCA) nativo, o que pode comprometer os resultados clínicos pós-operatórios(2,3). Análises biomecânicas e estudos comparativos reforçam que a reconstrução anatômica do LCA, com o posicionamento adequado do enxerto, proporciona resultados superiores em termos de estabilidade articular(4). Diante dessas evidências, as técnicas de reconstrução anatômica túnel independente, que possibilitam maior precisão no posicionamento femoral, têm se consolidado como abordagem preferencial na prática ortopédica atual(5).

O posicionamento anatômico dos túneis tibial e femoral na reconstrução do LCA demonstrou melhor restauração da translação anterior da tíbia, da estabilidade rotacional do joelho e da cinemática articular(6), levando a melhores desfechos clínicos e biomecânicos(7). Apesar dos bons resultados da RLCA, alguns estudos apontam uma taxa de revisão de até 25%(8). As principais causas da necessidade de revisão da RLCA são multifatoriais, incluindo fatores técnicos, traumáticos e biológicos(9), sendo que o fator técnico desempenha um papel importante nas causas de necessidade de revisão de RLCA, visto que, evidências indicam que 47,6% dos pacientes que necessitam de revisão da

RLCA apresentam o túnel femoral fora da posição anatômica(10), o que reforça o debate contínuo sobre os métodos mais confiáveis para se obter um posicionamento anatomicamente adequado do túnel femoral(6). Uma análise com 221 cirurgiões de alto volume cirúrgico demonstrou que 18% deles posicionaram o túnel femoral fora da área nativa do LCA, mesmo com a intenção de fazê-lo de forma anatômica(11). Isso se deve à dificuldade de identificação do local exato da inserção femoral do LCA durante a cirurgia.

A inserção femoral do LCA foi medida por Bernard et al.(12), por meio do método dos quadrantes de Bernard e Hertel, uma técnica radiográfica baseada em um quadrante aplicado a uma radiografia em perfil absoluto do joelho. Nesse método, a inserção femoral do LCA localiza-se a 25% do diâmetro sagital total do côndilo femoral lateral ao longo da linha de Blumensaat (de posterior para anterior) e a 29% da altura do côndilo, medida perpendicularmente à linha de Blumensaat (de superior para inferior). Esse método foi inicialmente descrito em um estudo cadavérico com radiografia simples e, posteriormente, adaptado para avaliação por tomografia computadorizada(13). No entanto, outros estudos mais recentes relataram diferentes porcentagens para a inserção femoral do LCA(14), demonstrando uma grande variabilidade anatômica e dificuldade em determinar corretamente o verdadeiro sítio de inserção femoral do LCA.

A filosofia por trás da reconstrução anatômica do LCA com feixe único é definida como uma restauração funcional do ligamento nativo, onde o túnel femoral deve ser posicionado de forma que mimetize as características biomecânicas do LCA original(15). Isso pode ser feito com o túnel posicionado posteriormente, ao longo da porção medial do côndilo femoral lateral, sobre a área anatômica do feixe anteromedial (AM), ou entre os feixes AM e

posterolateral, denominada posição central(15). Evidências na literatura mostram que o posicionamento do túnel femoral na região do feixe AM durante a reconstrução com feixe único promove boa estabilidade ântero-posterior(16,17), menor tensão sobre o enxerto(18,19) e menores taxas de revisão(20).

Dessa forma, diversos métodos foram desenvolvidos para estimar a posição do túnel femoral durante a cirurgia. Os mais utilizados na prática clínica são o método do “relógio”(21) e os marcos anatômicos(22), mas ambos apresentam limitações e podem levar ao posicionamento não anatômico do túnel femoral(11).

A cartilagem posterior do côndilo femoral lateral (ponto C), descrita por Cury et al.(23), é uma estrutura de fácil reconhecimento e pouca variação anatômica. O ponto C pode ser utilizado como um marco anatômico para replicar a posição do feixe AM, porém, até o momento, não existem estudos que avaliem a acurácia dessa técnica *in vivo* utilizando a abordagem de fora para dentro visando a reconstrução anatômica do túnel femoral sobre a banda AM.

2 OBJETIVO

O objetivo deste estudo foi analisar a acurácia do posicionamento do túnel femoral durante a reconstrução do LCA utilizando o ponto C como referência anatômica. A hipótese foi de que o ponto C é um marco anatômico capaz de auxiliar o cirurgião com precisão na criação do túnel femoral mais próximo possível do centro do feixe AM.

3 METODOLOGIA

3.1 DESENHO DO ESTUDO

Esse é um estudo prospectivo de uma série de casos, em que a coleta de dados dos pacientes operados ocorreu conforme os pacientes incluídos no estudo, que assinaram o termo de consentimento livre esclarecido (TLCE), foram realizando os procedimentos cirúrgicos.

O estudo foi conduzido entre dezembro de 2022 e dezembro de 2023 pelo Grupo de Cirurgia do Joelho do Departamento de Ortopedia e Traumatologia da Irmandade da Santa Casa de Misericórdia de São Paulo, Pavilhão “Fernandinho Simonsen”, sendo aprovado pelo Comitê de Ética em Pesquisa (CEP) da instituição no dia 25 de outubro de 2022.

3.2 ÉTICA

A pesquisa foi conduzida em conformidade com os princípios éticos estabelecidos e foi aprovada pelo Comitê de Ética em Pesquisa da Irmandade da Santa Casa de Misericórdia de São Paulo no dia 25 de outubro de 2022. sob o número de registro do CAAE(Certificado de Apresentação para Apreciação Ética) 63270422.0.0000.5479. Todos os participantes do estudo assinaram o TLCE, concordando voluntariamente em participar da pesquisa.

3.2 CRITÉRIOS DE INCLUSÃO

Foram incluídos no estudo pacientes de ambos os sexos, com idade mínima de 18 anos e máxima de 55 anos, com diagnóstico de lesão unilateral isolada de LCA, operados pelo mesmo cirurgião, entre dezembro de 2022 e

dezembro de 2023. Para ser incluído no estudo, o paciente deveria ter uma lesão com duração maior que duas semanas e menor do que 5 anos, além de não ter nenhum procedimento prévio no joelho acometido.

3.3 CRITÉRIOS DE EXCLUSÃO

Foram excluídos do estudo pacientes com fise de crescimento aberta ou deformidades no plano coronal com mais de 15º de varo ou valgo, que necessitariam de uma osteotomia corretiva associada. Além disso, foram excluídos pacientes com lesões multiligamentares do joelho (pacientes que além de apresentarem lesão de LCA, apresentaram lesões de ligamentos colaterais medial e lateral ou ligamento cruzado posterior), pacientes com lesões condrais que necessitariam de transplantes osteocondrais autólogos ou alógenos, ou implantação de membrana de colágeno. Pacientes com osteoartrose com grau maior do que 2, de acordo com a classificação de Kellgreen e Lawrence (diminuição do espaço articular maior que 5 mm comparado com o joelho contralateral associado com formação de osteófitos)(24), doenças inflamatórias sistêmicas ou índice de massa corporal (IMC) maior que 35 kg/m² também foram excluídos do estudo.

3.4 TÉCNICA CIRÚRGICA (25)

Os pacientes foram posicionados em decúbito dorsal horizontal, sob raquianestesia. Os tendões dos músculos grácil e semitendinoso, do mesmo lado da lesão, foram coletados para a confecção de um enxerto quádruplo. Foram criados portais artroscópicos anteromedial, anterolateral e medial acessório. Após inspeção da cavidade articular e avaliação de lesões meniscais

e condrais, as fibras do LCA rompido foram debridadas, e a parede medial do côndilo femoral lateral foi preparada com um shaver artroscópico e radioablação (Coolcut®, Arthrex, Inc., Naples, Florida), identificando-se a cartilagem posterior do côndilo femoral lateral, denominada ponto C (Figura 1).

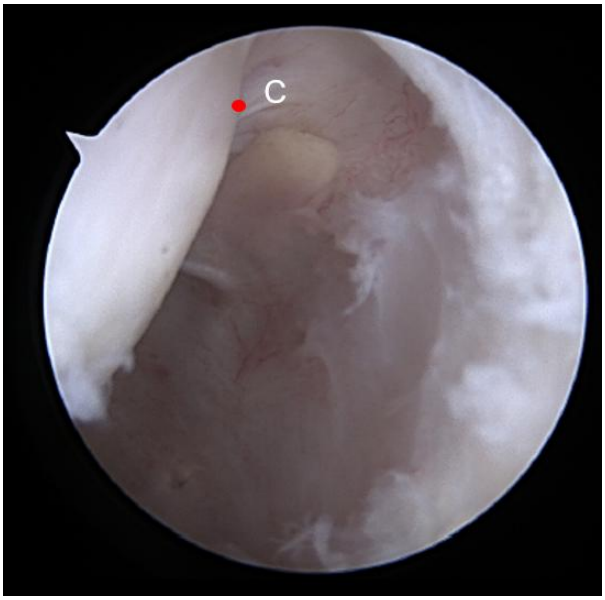

Figura 1 – Visualização artroscópica de um joelho direito fletido a 90 graus, através do portal anteromedial. Sendo possível visualizar a porção mais proximal e posterior da cartilagem posterior do côndilo femoral lateral – “ponto C” (ponto vermelho).

Com o joelho fletido a 90°, o artroscópio foi introduzido pelo portal medial acessório, permitindo melhor visualização da parede intercondilar lateral. Um guia femoral, utilizando a técnica de fora para dentro (Curved Marking Hook Femoral ACL®, Arthrex, Inc., Naples, Florida), foi inserido pelo portal anterolateral e posicionado com o joelho a 90°, medindo-se a distância entre o ponto C e a borda anterior do côndilo femoral lateral — denominada distância XY (Figuras 2A e 2B).

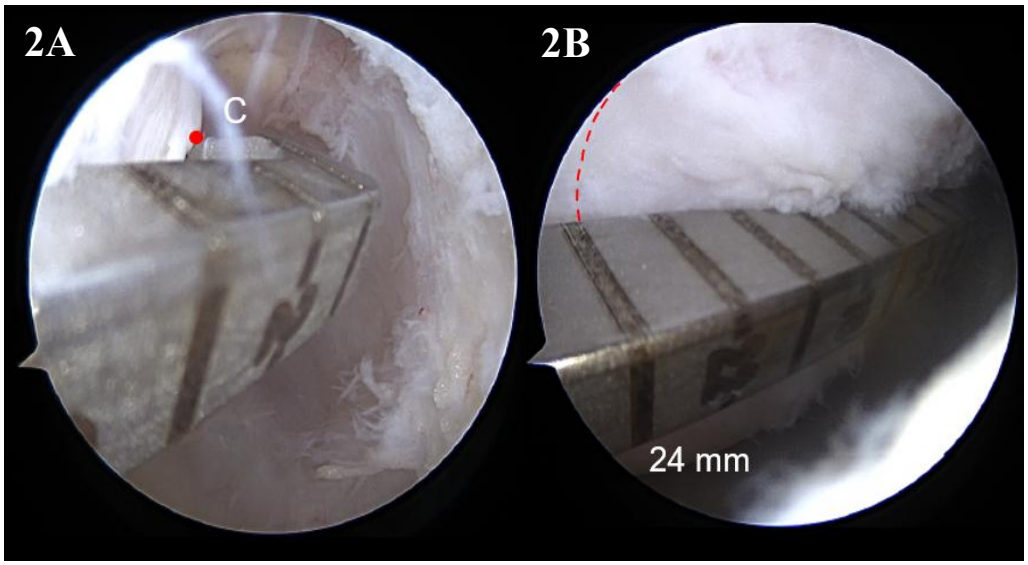

Figura 2 – (A) Visualização artroscópica de um joelho direito pelo portal anteromedial evidenciando a inserção do guia femoral pelo portal anterolateral, posicionado paralelo à tíbia, com o joelho em 90º de flexão, sobre o ponto C (ponto vermelho). **(B)** É realizada a aferição da distância entre a margem anterior do côndilo femoral lateral (distância XY) ao ponto C, dando o valor de 24 milímetros nesse paciente (linha pontilhada vermelha).

A partir do limite posterior da distância XY, com o joelho ainda fletido a 90°, mediu-se um valor correspondente a 35% da XY no sentido póstero-anterior, representando a coordenada sagital. A partir desse ponto, marcou-se um ponto 2 mm proximalmente utilizando radiofrequência ou um instrumental para punção óssea (“ice pick”), introduzido pelo portal anteromedial acessório. Esse ponto corresponde ao centro do feixe anteromedial (AM) nativo do LCA.

A partir da coordenada estabelecida, o fio-guia foi introduzido com auxílio do guia (Figuras 3A e 3B), e então o túnel femoral foi confeccionado com diâmetro proporcional ao enxerto (Figura 4). O centro do túnel tibial foi

determinado com base no remanescente tibial das fibras do LCA e perfurado pela técnica “de fora para dentro” utilizando um guia específico.

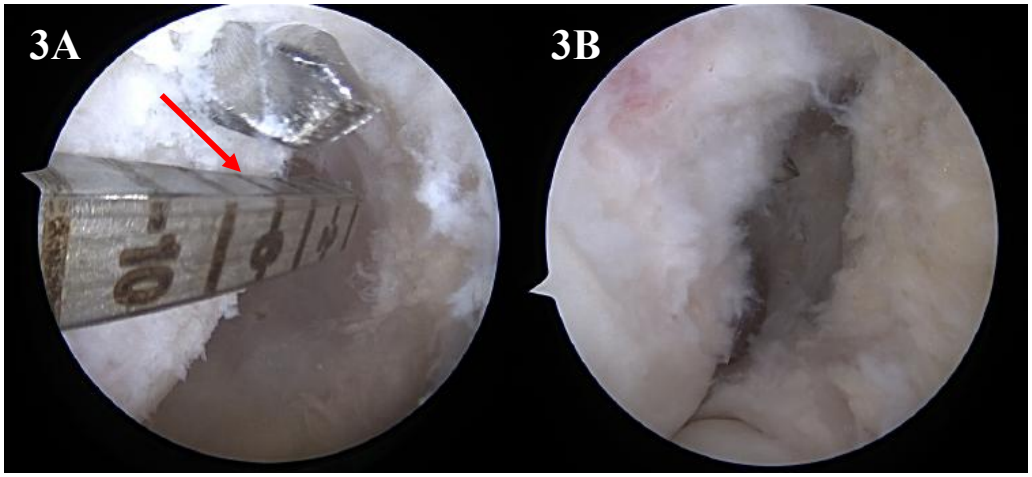

Figura 3 – (A) Visualização artroscópica de um joelho direito fletido a 90º. O artroscópio é posicionado pelo portal acessório medial. Pelo portal anterolateral o guia femoral é posicionado a uma distância equivalente a 35% da medida da distância entre a margem anterior do côndilo femoral lateral e o ponto C e 2 mm proximalmente. Neste paciente foi encontrado o valor de 8 mm (seta vermelha). **(B)** Visualização do fio guia quando o artroscópio é posicionado pelo portal anterolateral.

O enxerto dos flexores foi passado entre os túneis sob visualização artroscópica e fixado com parafusos de interferência bioabsorvíveis (Biocomposite, Arthrex, Inc., Naples, Florida). No fêmur, a fixação foi realizada pela técnica de “fora para dentro”, com o joelho a 90° de flexão e o parafuso posicionado superiormente ao enxerto. Na tíbia, a fixação foi feita com o joelho em extensão total, e o parafuso posicionado anteriormente ao enxerto e com tensão adequada.

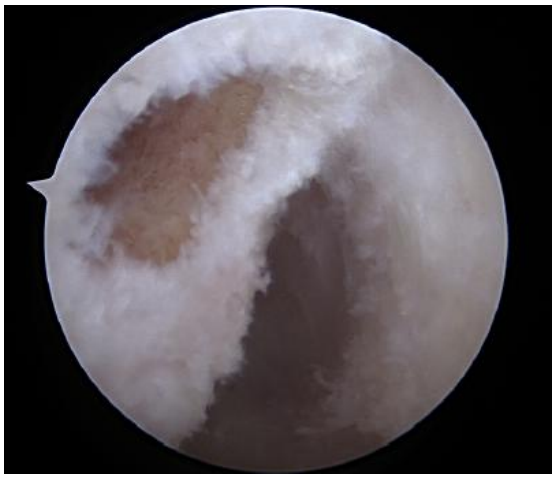

Figura 4 – Relação entre o túnel femoral sobre a banda anteromedial e o ponto C.

3.5 AVALIAÇÃO TOMOGRÁFICA

Nas primeiras 24 horas após o procedimento cirúrgico, todos os pacientes incluídos no estudo foram submetidos a exame de tomografia computadorizada (TC) multislice com tecnologia de 64 canais (Somaton, Siemens Medical Solutions, Forchheim, Alemanha), com espessura de corte de 1,25 mm. Após a aquisição das imagens, os arquivos foram transferidos para um software de avaliação tridimensional (RadiAnt DICOM Viewer 64-bit, Medixant, Poznan, Polônia). As imagens foram orientadas de forma a obter uma secção sagital verdadeira do joelho (perfil absoluto do joelho), com remoção do côndilo femoral medial com a região central sendo a incisura intercondilar.

Utilizando o programa Adobe Photoshop CS3 (Adobe Systems, San Jose, CA), foi criado um contorno retangular, adotando-se o método dos quadrantes de Bernard, modificado para reconstrução tridimensional em TC(13). O eixo horizontal do método representa o diâmetro sagital total do côndilo femoral lateral ao longo da linha de Blumensaat (distância **t**), expresso como porcentagem de 0% a 100% (de posterior para anterior). O eixo vertical corresponde à distância

perpendicular da borda distal do côndilo femoral lateral até a linha de Blumensaat (distância **h**), também expressa como porcentagem de 0% a 100% (de superior para inferior).

A posição do centro do túnel femoral foi definida com base na margem intra-articular do túnel femoral e plotada sobre a grade dos quadrantes. As coordenadas: horizontal (**X**) e vertical (**Y**) desse ponto foram registradas em valores percentuais (Figura 5). Os valores médios dessas coordenadas foram então comparados com os dados previamente estabelecidos para os valores da inserção femoral do feixe AM conforme o método de Bernard et al. Segundo a revisão sistemática de Xu et al.(14), os valores médios descritos para a coordenada "**X**" foram de 24.2% ± 4.0%, e para a coordenada "**Y**" de 21.6% ± 5.2%.

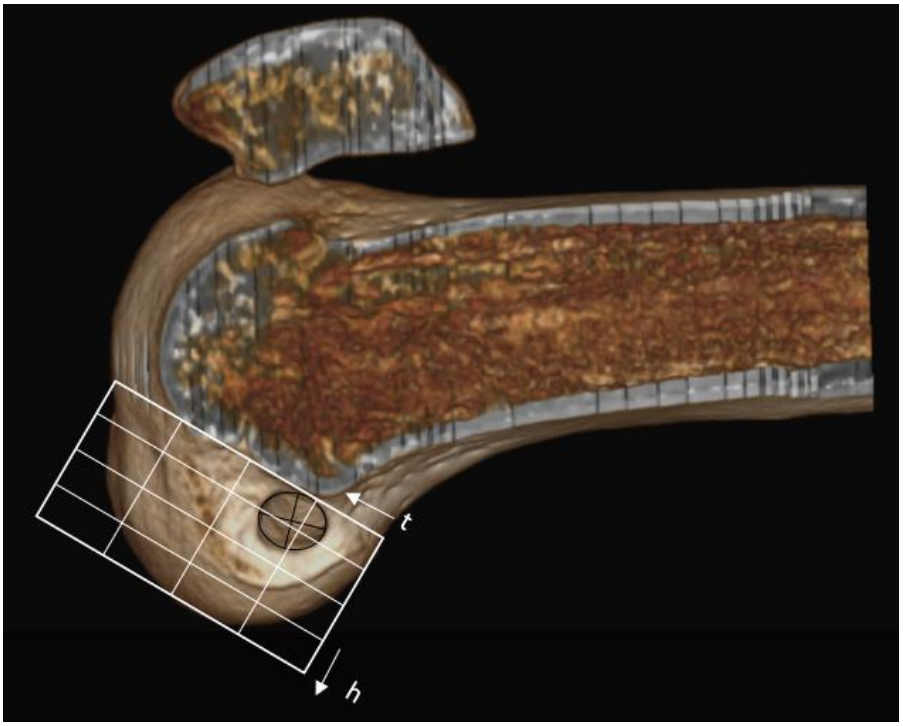

Figura 5 – Avaliação com auxílio de tomografia computadorizada com reconstrução tridimensional (TC 3D) com o côndilo femoral medial removido e o joelho em um perfil absoluto. Um contorno retangular é criado com base no método dos quadrantes de Bernard adaptado para TC 3D. O limite horizontal corresponde ao diâmetro sagital total do côndilo femoral margeando a linha de Blummensaat (distância *t*), medido em porcentagem (0-100% - fundo/raso). A porção vertical do quadrante corresponde à distância total do côndilo perpendicular à linha de Blumensaat (distância *h*), também medida em porcentagem (0-100% - alto/baixo). A localização do túnel femoral dentro do quadrante é identificada.

A análise das tomografias, para determinação das coordenadas percentuais do posicionamento de cada túnel femoral, foi realizada por dois cirurgiões com níveis distintos de experiência: um especialista com mais de 30 anos de atuação em cirurgia do joelho e um cirurgião recém-especializado. As avaliações foram realizadas em momentos diferentes, com intervalo de 15 dias entre elas, e os avaliadores não tiveram acesso às análises previamente realizadas um pelo outro. Após a coleta das amostras e análises subsequentes, os valores médios das mensurações foram calculados e comparados com os dados já descritos na literatura sobre a localização do feixe AM (X = 24.2 ± 4.0%; Y = 21.6 ± 5.2%)(14)

3.6 ANÁLISE ESTATÍSTICA

Foi adotado um nível de significância estatística de 0,05. As variáveis demográficas e os dados dos exames de imagem foram caracterizados, considerando-se normais os valores de altura e profundidade que se mantiveram dentro da faixa previamente descrita na literatura(14). Valores acima ou abaixo desses limites foram considerados anormais. Para verificar a significância entre as proporções calculadas, foi utilizado o teste Z para duas proporções.

Para avaliar a confiabilidade das variáveis, os dados do avaliador 1 foram analisados quantitativamente com cálculo do coeficiente de correlação intraclasse (ICC), erro padrão da medida (SEM) e erro padrão de estimativa (SEE). Para o ICC, os valores foram classificados como: baixo (0 a 0,5), moderado (0,5 a 0,75), bom (0,75 a 0,9) e excelente (0,9 a 1,0)(26).

Uma análise de poder estatístico (software GPower 3.1.9.4), com correlação esperada alta (r = 0,5) com base em estudo prévio(27), determinou o tamanho amostral necessário de 45 pacientes para um poder estatístico de 80%.

4 RESULTADOS

Inicialmente, 59 pacientes foram selecionados para o estudo. No entanto, dois foram excluídos por apresentarem imaturidade esquelética (fise de crescimento aberta) e idade inferior a 18 anos, dois tinham mais de 55 anos, quatro apresentavam osteoartrose com grau superior ao grau II segundo a classificação de Kellgren e Lawrence(24), um necessitou de osteotomia concomitante devido a desvio do eixo no plano coronal, e três apresentavam índice de massa corporal (IMC) superior a 35 kg/m². Esses pacientes foram excluídos da análise e; portanto, não realizaram a RLCA utilizando o ponto C como marco anatômico, não sendo submetidos à avaliação por tomografia computadorizada (TC) pós-operatória. Após essas exclusões, 47 pacientes foram submetidos à RLCA utilizando o ponto C como marco anatômico para posicionamento do túnel femoral sobre a banda AM (Figura 6). Nenhum exame de TC foi excluído por baixa qualidade de imagem.

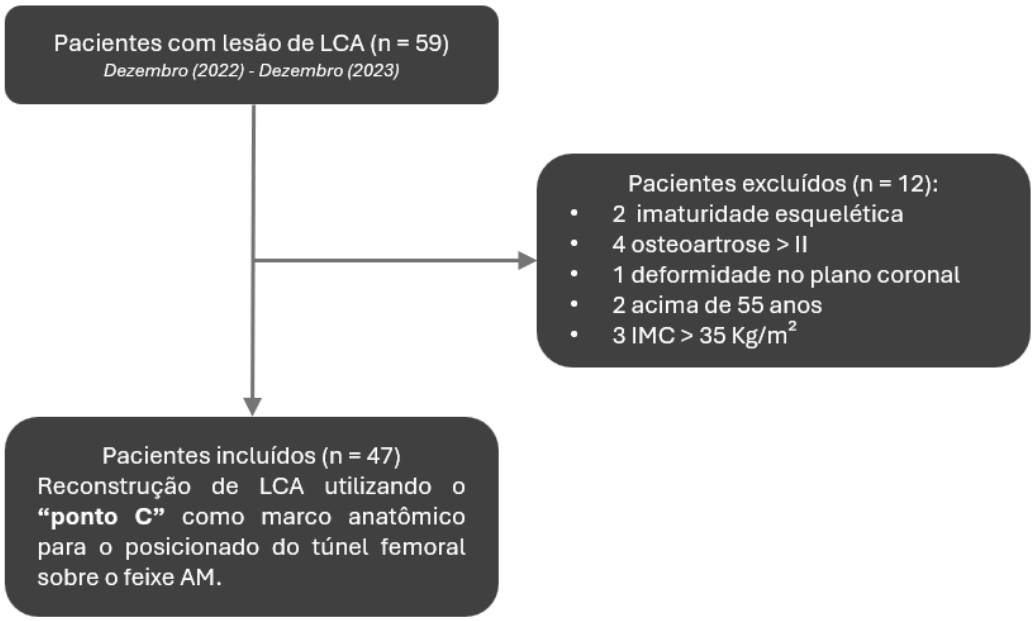

Figura 6 – Fluxograma descrevendo os critérios de seleção dos pacientes. *LCA*: ligamento cruzado anterior. *IMC*: índice de massa corporal. *AM*: anteromedial. *TC:* tomografia computadorizada. *n:* número de pacientes

A média de idade dos pacientes foi de 32 anos, com variação entre 18 e 51 anos. Dentre os casos, 28 apresentavam lesão de LCA do joelho direito e 19 do joelho esquerdo. A amostra foi composta por 14 pacientes do sexo feminino e 33 do sexo masculino. Todos os pacientes apresentavam lesão crônica do LCA, definida como intervalo superior a três meses entre a lesão e a cirurgia (Tabela 1).

Tabela 1 – Dados demográficos do estudo

Característica dos pacientes	Média (intervalo)	Porcentagem	Desvio Padrão	N
Idade (anos)	32 (18-49)		10.1	47
Joelho operado				
Esquerdo		40.4%		19
Direito		59.6%		28
Sexo				
Masculino		70.2%		33
Feminino		29.8%		14
Índice de massa corporal (IMCA)(kg/m²)	25.2 (20.1 – 30.4)		2.3	47
Diâmetro do túnel[a] (mm)	8.3 (7 – 10)		0.9	47
Tempo entre a lesão e a cirurgia (meses)	8 (4 – 24)		4.7	47

[a] Medida do túnel femoral após a perfuração. N= número de pacientes. mm = milímetros

A distância média entre o ponto C e a borda anterior do côndilo femoral lateral foi de 23.3 mm, com valores variando entre 22.0 mm e 26.0 mm. A média de correlação intraoperatória entre o ponto C e o centro do feixe AM, na coordenada horizontal, foi de 7.0 mm, variando de 7.0 mm a 9.0 mm.

Pelo avaliador 1, os valores médios de profundidade (coordenada X) foram de 23.6% nas análises dos tempos 1 e 2. Os valores médios de altura (coordenada Y) foram de 22.7% no tempo 1 e 22.0% no tempo 2, respectivamente. A avaliação realizada pelo segundo avaliador, no terceiro tempo, apresentou valor médio da coordenada X de 23.6% e da coordenada Y de 22.3% (Tabela 2; Figura 7).

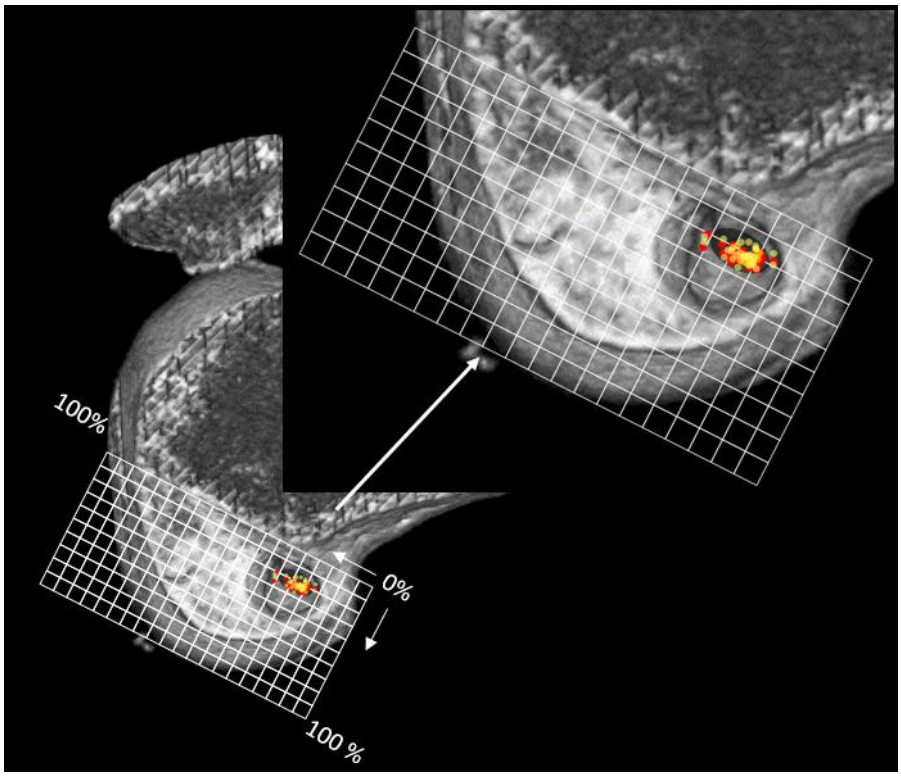

Figura 7 – Representação dos resultados dentro dos quadrantes de Bernard (horizontal: *t* e vertical: *h*). Na imagem superior, o círculo preto representa os valores das coordenadas da banda anteromedial na literatura (*t:* 24.2 ± 4.0% e *h*: 21.6 ± 5.2%). Os 47 pacientes avaliados pelo avaliador 1 no primeiro tempo estão representados em vermelho. Os 47 pacientes avaliados pelo avaliador 1 no primeiro tempo estão representados em amarelo

Tabela 2 – Descrição completa dos fatores quantitativos

	Média	**Mediana**	**Desvio Padrão**	**N**	**CI**	**SEE**	**ICC**	**SEM**
Idade (anos)	32	33	10.1	47	2.9	1.5		
Distância CD (mm)	23.3	24	1.3	47	0.4	0.2		
Distância do ponto C ao centro do túnel femoral (mm)	7.7	8	0.7	47	0.2	0.10		
Profundidade 1º Tempo Avaliador 1	23.6%	23.6 %	2.3%	47	0.7%	0.3%	0.942	0.6%
Profundidade 2º Tempo Avaliador 2	23.6%	23%	2.6%	47	0.7%	0.4%		
Altura 1º Tempo Avaliador 1	22.7%	22.4%	2.0%	47	0.6%	0.3%	0.791	0.9%
Altura 2º Tempo Avaliador 2	22.1%	22.1%	2.1%	47	0.6%	0.3%		
Profundidade 2º Avaliador	23.6%	23%	2.5%	47	0.7%	0.4%		
Profundidade 2º Avaliador	22.3%	22.1%	1.8%	47	0.5%	0.3%		

N = Número de pacientes. CI = Intervalo de confiança. SEE = Erro padrão médio. ICC = Índice de correlação Intraclasses. SEM = Erro padrão de medição. CD = avaliação intra-operatória da distância entre o ponto C e a porção mais anterior do côndilo femoral lateral. mm = Milímetros.

Entre os 47 pacientes avaliados, em todas as medições, a coordenada Y (altura) permaneceu dentro do intervalo anatômico descrito para o feixe AM (21.6% ± 5.2%)(14). Em relação à coordenada X (profundidade), três casos avaliados pelo avaliador 1 ficaram fora da margem estabelecida para o feixe AM (24.2% ± 4.0%)(14): um túnel foi posicionado posteriormente (19.5% na análise 1 e 18.9% na análise 2) e dois anteriormente (29.5% e 28.9% na análise 1; 31.3% na análise 2). Na terceira análise, conduzida pelo segundo avaliador, dois túneis foram posicionados posteriormente (19.4% e 18.2%) e dois anteriormente (31.2% e 28.9%) (Tabela 3).

Tabela 3 - Distribuição dos Fatores Qualitativos

		N	**%**	**P-valor**
Joelho Operado	Direito	28	59,6%	0,063
	Esquerdo	19	40,4%	
Sexo	Feminino	14	29,8%	<0,001
	Masculino	33	70,2%	
Altura (T1 – Avaliador 1)	Normal	47	100%	<0,001
	Alterado	0	0%	
Altura (T1 – Avaliador 2)	Normal	47	100%	<0,001
	Alterado	0	0%	
Altura (T2 – Avaliador 1)	Normal	47	100%	<0,001
	Alterado	0	0%	
Profundidade (T1 – Avaliador 1)	Normal	44	93,6%	<0,001
	Alterado	3	6,4%	
Profundidade (T1 – Avaliador 2)	Normal	43	91,5%	<0,001
	Alterado	4	8,5%	
Profundidade (T2 – Avaliador 1)	Normal	44	93,6%	<0,001
	Alterado	3	6,4%	

T1 = Primeiro tempo. T2 = Segundo tempo. N = Número de pacientes

A acurácia da altura foi de 100% nas três medições. Em relação à profundidade, os valores de acurácia variaram entre 91.5% e 93.6% (Tabela 4). O coeficiente de correlação intraclasse (ICC) para a confiabilidade intra e

interobservador foi de 0.942 para profundidade e 0.791 para altura, respectivamente (Tabela 2).

Tabela 4 – Acurácia do ponto C

	Altura		**Profundidade**	
	Acurácia	IC	Acurácia	IC
T1 - Aval 1	100%	0,0%	93,6%	7,0%
T1 - Aval 2	100%	0,0%	91,5%	8,0%
T2 - Aval 1	100%	0,0%	93,6%	7,0%

T1 = Tempo 1. T2 = Tempo 2. IC = Intervalo de confiança. Aval = Avaliador.

5 DISCUSSAO

O principal achado deste estudo foi a alta acurácia na utilização do ponto C como referência anatômica para a criação do túnel femoral sobre o feixe AM durante a RLCA, por meio da técnica de “fora para dentro”. Após a realização da técnica cirúrgica em 47 casos e avaliação do posicionamento do túnel femoral por TC 3D, a técnica demonstrou boa precisão, com posicionamento dentro dos valores anatômicos descritos para o feixe AM em 100% dos casos na variável de altura. Em relação à profundidade, 93.6% dos pacientes apresentaram o centro do túnel dentro das coordenadas do feixe AM segundo o avaliador 1, e 91.5% segundo o avaliador 2. Esses resultados estão em consonância com o estudo de Cury et al.(23), uma vez que o parâmetro de profundidade apresentou maior variabilidade entre os espécimes analisados, sendo essa menor acurácia já esperada.

Neste estudo, os valores médios do feixe AM em profundidade foram de 23.6% ± 2.3, e em altura de 22.7% ± 2.0. Esses dados, obtidos a partir do sistema de quadrantes de Bernard(12), foram semelhantes aos apresentados na revisão

sistemática de Xu et al.(14). Tsukada et al.(28) descreveram o feixe AM, dentro do sistema de quadrantes de Bernard(12) como estando a 25.9% ± 2.0 da cartilagem posterior do côndilo femoral lateral até a borda anterior da cartilagem, e a 17.8% ± 2.9 da linha de Blumensaat até a borda inferior da cartilagem femoral. Outras revisões sistemáticas também buscaram determinar a posição da inserção femoral do LCA dentro do sistema de quadrantes. Piefer et al.(29), por exemplo, descreveram o centro do feixe AM como estando a 29.5% do comprimento proximal/distal da parede intercondilar lateral, e 2.5 mm anterior à margem da cartilagem posterior. Essas discrepâncias entre os estudos podem ser atribuídas a diferentes métodos de dissecção de cadáveres, variação nos tipos de imagem utilizados, e à dificuldade em determinar precisamente a inserção femoral do LCA. Além disso, enquanto o método original de Bernard foi desenvolvido para avaliação radiográfica, o presente estudo utilizou uma versão modificada adaptada à imagem por TC(13). Apesar dessa variabilidade, os resultados encontrados foram semelhantes aos descritos por Xu et al.(14) e Tsukada et al.(28).

Diversas técnicas cirúrgicas foram desenvolvidas para auxiliar o cirurgião na criação do túnel femoral na RCLA. Atualmente, as mais utilizadas são a técnica do “relógio”(21), os marcos anatômicos(22) e os remanescentes do LCA nativo(30).

A técnica do “relógio”(21) é uma das técnicas mais tradicionais que foi implementada para realização do túnel femoral. A premissa da técnica consiste em visualizar uma figura imaginária de um relógio dentro da incisura intercondilar, usando o ponteiro do relógio imaginário como um marco para avaliar o posicionamento do túnel femoral na parede medial do côndilo lateral. A

técnica demonstrou algumas limitações, como a impossibilidade de avaliar a profundidade da parede intercondilar, desconsiderar os marcos anatômicos do LCA e a posição do relógio alterar conforme o grau de flexão do joelho(31). Wittstein et. al(32) avaliaram que a técnica do relógio apresenta interpretação variável entre cirurgiões, mesmo com níveis diferentes de experiência.

Ferretti et. al(22) descreveram os marcos anatômicos para identificação da inserção femoral do LCA. Os marcos consistem na crista lateral intercondilar e a crista bifurcada. Tsukuda et. al(33) evidenciaram que a crista lateral intercondilar pode apresentar variações anatômicas entre indivíduos. Van Eck et al(34) avaliaram que a crista lateral intercondilar foi identificada em 88% dos casos, enquanto a crista bifurcada foi identificada em 48% dos casos em sua amostra. Evidenciando que a utilização dos marcos anatômicos pode não ser fidedigna em todos os casos de RLCA.

O uso do remanescente da inserção femoral do LCA(30) é uma maneira prática de realizar o túnel femoral, no entanto, nem sempre pode estar presente, principalmente em casos crônicos, e o remanescente pode estar cicatrizado em uma região fora da inserção nativa femoral do LCA(35).

Considerando a grande variabilidade desses marcos anatômicos, alguns estudos buscaram identificar novas referências que auxiliem na criação do túnel femoral. Weiler et al.(27) utilizaram o corno posterior do menisco lateral para posicionar o túnel femoral na região central, com perfuração do túnel pelo portal anteromedial. O uso da cartilagem posterior do côndilo femoral lateral como referência anatômica para a criação do túnel femoral já foi descrito como um marco confiável para o posicionamento durante a reconstrução do LCA(36–38). Dong et al.(36), em uma série retrospectiva de casos, utilizaram a porção mais

proximal e posterior da cartilagem femoral lateral como referência anatômica, posicionando uma régua artroscópica a 12.0 mm anteriormente à cartilagem e 3.0 mm superiormente, utilizando a técnica de perfuração de “dentro para fora”. Relataram posicionamento adequado do túnel e bons desfechos pós-operatórios. Em comparação com a presente análise, a distância entre o ponto C e o centro do túnel femoral variou entre 7.0 a 9.0 mm, o que pode ser atribuído à diferença anatômica entre os pacientes, especialmente em função da estatura e tamanho da incisura intercondilar.

De acordo com Shi et al.(38), a distância entre o túnel femoral e a porção mais proximal e distal da cartilagem femoral lateral é de 9.0 ± 1.2 mm.

Até o momento na literatura, não há estudos que tenham descrito uma técnica — e sua reprodutibilidade *in vivo* — utilizando o ponto C como referência para replicar o feixe AM em RLCA com feixe único e técnica “de fora para dentro”.

Em relação ao posicionamento do túnel femoral sobre o feixe AM ou em posição central, estudos biomecânicos demonstraram que o túnel posicionado na porção central apresenta comportamento não-isométrico(17), enquanto um posicionamento excêntrico mais próximo ao feixe AM pode estar associado a melhores resultados clínicos(39).

Em estudos cadavéricos, o posicionamento do túnel próximo ao feixe AM demonstrou melhor controle da estabilidade ântero-posterior e rotacional em comparação com posicionamentos mais próximos ao feixe póstero-lateral(40). Da mesma forma, a reconstrução com túnel próximo ao feixe AM apresentou menor tensão sobre o enxerto(41). Estudos prospectivos demonstraram que quanto mais próximo o túnel femoral estiver da origem do feixe AM, em

comparação à posição central, melhores serão os desfechos clínicos pós-operatórios, com base na avaliação objetiva pelo teste de Lachman e pelo escore IKDC (International Knee Documentation Committee), além de menores taxas de revisão(20,39).

No presente estudo, o objetivo não foi comparar as duas técnicas cirúrgicas, mas sim avaliar a acurácia da técnica utilizando o ponto C como referência anatômica para criação do túnel femoral o mais próximo possível do feixe AM. Uma análise biomecânica e funcional pós-operatória seria necessária para comparar a diferença de RLCA utilizando os túneis em posição central e sobre o feixe AM, o que não foi proposto neste estudo.

Alguns estudos anatômicos demonstram que há variabilidade na forma e no tamanho da inserção femoral do LCA(42,43), tornando a reconstrução anatômica do túnel femoral um desafio. Outro fator que pode influenciar a criação do túnel é a morfologia do teto intercondilar, a qual pode afetar significativamente o posicionamento do túnel, especialmente em casos em que há inclinação excessiva do teto intercondilar, levando à criação de túneis mais distais quando o cirurgião realiza o túnel femoral sobre o feixe AM(44). Essa variabilidade anatômica não foi considerada neste estudo, mas pode estar relacionada aos casos em que a profundidade do túnel não esteve dentro dos parâmetros estabelecidos para o feixe AM (3 casos segundo o avaliador 1, e 4 casos segundo o avaliador 2). Estudos futuros são necessários para correlacionar a o posicionamento do túnel com a morfologia do teto intercondilar.

Este estudo apresenta algumas limitações. Primeiramente, trata-se de uma análise baseada exclusivamente em exames de imagem, sem avaliação clínica funcional de longo prazo investigando os desfechos clínicos, nível de

satisfação dos pacientes ou ocorrência de complicações. São necessárias análises prospectivas futuras. Em segundo lugar, todas as cirurgias foram realizadas por um único cirurgião, o que limita a validação externa da técnica; a realização da técnica por diferentes cirurgiões poderá confirmar a aplicabilidade em amostras maiores. Terceiro, a criação do túnel femoral foi realizada exclusivamente pela técnica “de fora pra dentro”, sem realização de casos com perfuração do túnel pelo portal anteromedial (técnica “de dentro para fora”). Além disso, trata-se de uma série de casos consecutivos com seguimento a curto prazo e sem grupo controle. Embora o objetivo do estudo tenha sido avaliar o posicionamento do túnel durante a reconstrução do LCA com feixe único, o delineamento metodológico limita a inferência sobre os resultados clínicos da técnica.

6 CONCLUSÃO

Com base nos resultados deste estudo, o ponto C pode ser considerado um marco anatômico confiável para a criação do túnel femoral, mimetizando a posição do feixe AM durante a RLCA.

O cirurgião deve utilizar múltiplos parâmetros intraoperatórios para garantir a criação do túnel de forma anatomicamente precisa, sendo o ponto C um recurso adicional válido.

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ANEXOS

ANEXO 1 – Aprovação do Comitê de Ética em Pesquisa em Seres Humanos

SANTA CASA DE
MISERICÓRDIA DE SÃO

Plataforma Brasil

PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: AVALIAÇÃO RADIOLÓGICA DA ACURÁCIA DA UTILIZAÇÃO DO PONTO C COMO INDICADOR PARA IDENTIFICAÇÃO DO TÚNEL FEMORAL NA RECONSTRUÇÃO ANATÔMICA DO LIGAMENTO CRUZADO ANTERIOR.

Pesquisador: Ricardo de Paula Leite Cury

Área Temática:

Versão: 1

CAAE: 63270422.0.0000.5479

Instituição Proponente: IRMANDADE DA SANTA CASA DE MISERICORDIA DE SAO PAULO

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 5.719.989

Apresentação do Projeto:

Introdução: A técnica de reconstrução do ligamento cruzado anterior (RLCA) vem sofrendo evolução nos últimos anos. O posicionamento anatômico dos túneis tibial e femoral demonstrou melhor restauração da translação tibial anterior, estabilidade rotacional e cinemática do joelho. Ao menos 1 entre 9 pacientes submetidos à RLCA irá apresentar falha clínica ou rerruptura à longo prazo. Sendo que o principal erro técnico da RLCA que irá

cursar com falha atraumática cirúrgica é o mau posicionamento dos túneis. Aventa-se que a cartilagem posterior do fêmur (ponto “C”), por ser um ponto fixo e sempre visível por meio dos portais artroscópicos, possa ser usada como um marco anatômico de referência para realização do túnel femoral. Objetivo: O objetivo do presente estudo é avaliar a acurácia do posicionamento do túnel femoral ao ser realizado tendo como marco de

referência o Ponto C. Métodos: Estudo transversal de acurácia, prospectivo, no qual pacientes submetidos à RLCA, no período de junho de 2022 à dezembro de 2023, utilizando como marco anatômico para confecção do túnel femoral o ponto C, irão realizar avaliação tomográfica pós operatória imediata para comparar o túnel femoral realizado com a inserção femoral nativa conforme o método de Bernard.

Objetivo da Pesquisa:

Avaliar a acurácia do posicionamento do túnel femoral ao ser realizado tendo como marco de

Endereço: Rua Marques de Itu, 381
Bairro: VILA BUARQUE **CEP:** 01.223-001
UF: SP **Município:** SAO PAULO
Telefone: (11)2176-1817 **E-mail:** cepsc@santacasasp.org.br

referência o Ponto C.

Avaliação dos Riscos e Benefícios:

Riscos:

Os riscos envolvidos no estudo são inerentes aos procedimentos cirúrgicos realizados. Dentre eles destacam-se complicações pós operatórias na RLCA como infecção de sítio cirúrgico, deiscência de ferida operatória, falha do enxerto, dor e atrofia muscular pós operatória reversível e riscos à exposição a radiação da TC. Porém os pacientes não serão expostos à riscos maiores que o necessário e os mesmos serão amenizados pelos protocolos hospitalares e cuidados ambulatoriais.

Benefícios:

Os benefícios serão a contribuição à ciência, avaliando a acurácia de um novo método de identificação do ponto da inserção femoral na RLCA.

Comentários e Considerações sobre a Pesquisa:

Pesquisa de interesse científico

Considerações sobre os Termos de apresentação obrigatória:

TCLE adequado

Conclusões ou Pendências e Lista de Inadequações:

aprovado

Considerações Finais a critério do CEP:

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1989435.pdf	13/09/2022 10:01:00		Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TLCEpontoC2.docx	13/09/2022 10:00:35	Ricardo de Paula Leite Cury	Aceito
Projeto Detalhado / Brochura Investigador	projetoPontoC.docx	23/08/2022 09:40:15	Ricardo de Paula Leite Cury	Aceito
Orçamento	Orcamento.pdf	23/08/2022 09:37:08	Ricardo de Paula Leite Cury	Aceito
Declaração de Instituição e	formulariodeautorizacao.pdf	23/08/2022 09:34:56	Ricardo de Paula Leite Cury	Aceito

Infraestrutura	formulariodeautorizacao.pdf	23/08/2022 09:34:56	Ricardo de Paula Leite Cury	Aceito
Declaração de concordância	AssessorCientifico.pdf	23/08/2022 09:34:28	Ricardo de Paula Leite Cury	Aceito
Declaração de Pesquisadores	termopesquisador.pdf	23/08/2022 09:21:08	Ricardo de Paula Leite Cury	Aceito
Cronograma	cronograma.docx	23/08/2022 09:16:14	Ricardo de Paula Leite Cury	Aceito
Folha de Rosto	folhaderosto_pontoC.pdf	23/08/2022 09:10:01	Ricardo de Paula Leite Cury	Aceito

Situação do Parecer:
Aprovado

Necessita Apreciação da CONEP:
Não

SAO PAULO, 25 de Outubro de 2022

Assinado por:
Vera Lúcia dos Santos Alves
(Coordenador(a))

ANEXO 2 – Termo de Consentimento Livre e Esclarecido

IPITEC
INSTITUTO DE PESQUISA, INOVAÇÃO TECNOLÓGICA E EDUCAÇÃO

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Caro Participante:

Gostaríamos de te convidar para participar voluntariamente da pesquisa intitulada "Avaliação radiológica da acurácia da utilização do ponto C como indicador para identificação do túnel femoral na reconstrução anatômica do ligamento cruzado anterior" que se refere a um projeto de Trabalho de Conclusão de Curso do participante Viktor Nelson Mazzola Corrêa, sob a orientação do Prof. Dr. Ricardo de Paula Leite Cury, o qual pertence ao Grupo de Joelho do Departamento de Ortopedia e Traumatologia da Faculdade de Ciências Médicas da Santa Casa de Misericórdia de São Paulo – DOT – FCMSCMSP.

Este estudo tem como objetivo avaliar uma nova técnica de realização da cirurgia de reconstrução do ligamento cruzado anterior, o que irá possibilitar uma possível melhora nos resultados pós operatórios do procedimento.

A sua forma de participação consistirá em realizar o procedimento cirúrgico proposto, caso haja indicação para a cirurgia e realizar uma tomografia pós operatória durante o internamento, o que não irá impactar o acompanhamento pós operatório ou o acompanhamento ambulatorial.

Este estudo contribuirá para o desenvolvimento de uma nova técnica cirúrgica.

Seu nome não será utilizado em qualquer fase da pesquisa, o que garante seu anonimato, e a divulgação dos resultados será feita de forma a não identificar os voluntários.

Não será cobrado nada, não haverá gastos e não estão previstos ressarcimentos ou indenizações, pois o estudo envolve o mesmo tratamento pós operatório, além de manter continuidade do melhor tratamento resultante do estudo, mesmo após o término do mesmo.

Considerando que toda pesquisa oferece algum tipo de risco, nesta pesquisa o risco pode ser avaliado como: exposição à tomografia computadorizada no pós operatório.

Gostaríamos de esclarecer que sua participação é voluntária e que poderá recusar-se a participar ou retirar o seu consentimento, ou ainda descontinuar sua participação se assim o preferir, sem penalização alguma ou sem prejuízo ao seu cuidado.

Caso aceite participar voluntariamente do estudo o senhor(a) ficará com uma cópia deste Termo de Consentimento Livre e Esclarecido.

Em qualquer etapa do estudo, o senhor(a) terá acesso aos profissionais responsáveis pela pesquisa para esclarecimento de dúvidas. O principal investigador é Viktor Nelson Mazzola Corrêa que pode ser encontrado(a) na Rua Dr. Cesário Mota Júnior 112, Grupo de Joelho do Departamento de Ortopedia da Irmandade da Santa Casa de Misericórdia de São Paulo - Vila Buarque - Cep: 01.221-010 – E-mail viktornelson3@gmail.com , Cel 41 98896-9535

Desde já, agradecemos sua atenção e participação e colocamo-nos à disposição para maiores informações. Acredito ter sido suficientemente informado a respeito das informações que li ou que foram lidas para mim, descrevendo o estudo "Avaliação radiológica da acurácia da utilização do ponto C como indicador para identificação do túnel femoral na reconstrução anatômica do ligamento cruzado anterior". Eu discuti com Viktor Nelson Mazzola Corrêa sobre a minha decisão em participar nesse estudo. Ficaram claros para mim quais são os propósitos do estudo, os procedimentos a serem realizados, seus desconfortos e riscos, as garantias de confidencialidade e de esclarecimentos permanentes. Ficou claro também que minha participação é isenta de despesas e que tenho garantia do acesso a tratamento hospitalar quando necessário. Concordo voluntariamente em participar do estudo e poderei retirar o meu consentimento a qualquer momento, antes ou durante o mesmo, sem penalidades ou prejuízo ou perda de qualquer benefício que eu possa ter adquirido, ou no meu atendimento neste serviço.

_____

Assinatura do paciente/representante legal. Data_____/_____/_____

_____

Assinatura da testemunha. Data_____/_____/_____

Para casos de voluntários, analfabetos, semianalfabetos ou portadores de deficiência auditiva ou visual.

Declaro que obtive de forma apropriada e voluntária o Consentimento Livre e Esclarecido deste paciente ou representante legal para a participação neste estudo.

_____

Assinatura do responsável pelo estudo. Data_____/_____/_____

ANEXO 3 – Carta de Aceite Revista “Journal of Experimental Orthopaedics”

Date: 03 Jul 2025
To: "Ricardo Cury" rcury1@me.com
From: "JEO Editorial Office" jeo@esska.org
Subject: Acceptance of your submission to Journal of Experimental Orthopaedics (jeo.202500027R3)

Dear Dr Cury,

Thank you for submitting your manuscript entitled "The posterior femoral cartilage can be used as an anatomical reference for the creation of the femoral tunnel in anterior cruciate ligament reconstruction" (Original Paper, No. jeo.202500027R3) to Journal of Experimental Orthopaedics.

I'm pleased to inform you that your manuscript has been accepted for publication without change.

Please note that your manuscript will undergo an integrity check, that includes the images. Publication will only proceed on the condition that all final files comply with the journal integrity checks. In the event that any file does not comply with our integrity checks, the journal reserves the right to rescind this decision, or, alternatively, you may be contacted to resolve any concerns raised by these checks.

All articles published in Journal of Experimental Orthopaedics are fully open access: immediately and freely available to read, download and share. Journal of Experimental Orthopaedics charges a publication fee to cover publication costs. The corresponding author for this manuscript should have already received a quote with the article publication fee, and will soon receive an e-mail invitation to register with or log in to Wiley Author Services (https://authorservices.wiley.com). After logging into Wiley Author Services, the publication fee can be paid by credit card, or an invoice or pro forma can be requested. Payment of the publication charge must be received before the article will be published online.

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Congratulations on your results, and thank you for choosing Journal of Experimental Orthopaedics for publishing your work. I hope you will consider us for the publication of your future manuscripts.

Yours sincerely,

Prof. Stefano Zaffagnini, Head Sports Traumatology Center

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Stefano Zaffagnini, Editor-in-Chief
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ESSKA Executive Office
Centre Medical
76, rue d’Eich
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E-mail: jeo@esska.org

ANEXO 4 – Normas de Publicação na revista “Journal of Experimental Orthopaedics”

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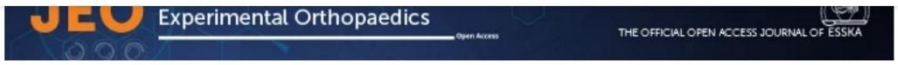

Author Guidelines

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This Journal operates a double-anonymized peer review process. Authors are responsible for anonymizing their manuscript in order to remain anonymous to the reviewers throughout the peer review process (see “Main Text File” below for more details). Since this journal also encourages posting of preprints, however, please note that if authors share their manuscript in preprint form this may compromise their anonymity during peer review.

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For specific instructions please click **here**.

If you have any questions please contact:

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Manuscript Submission

Manuscript Submission

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The journal asks authors to assign a Level of Evidence to all clinically oriented manuscripts.

Level of Evidence for the *Journal of Experimental Orthopaedics*

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Before you submit, you will need:

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section is not available, in a suitable alternative part) of the manuscript.

Abstract

Please note that the structured abstract of up to 300 words should be divided into the following FOUR sections:

- Purpose
- Methods
- Results
- Conclusions

For narrative reviews: Please provide a short, unstructured, single paragraph summary, no more than 350 words, of the major points raised, making evident the key work highlighted in the article.

For Case reports: Please provide a short, unstructured, single paragraph summary, no more than 100 words, of the major points raised, making evident the key work highlighted in the article.

Please do not use abbreviations or references in the abstract.

Keywords

Three to 10 keywords representing the main content of the article.

Keywords are required for the following article categories: Book Reviews, Case Reports, Editorial notes, Study Protocols, Hypotheses, Meeting Reports, Original Papers and Review Papers.

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Text

Text Formatting: Manuscripts should be submitted in Word.

- Use a normal, plain font (e.g., 10-point Times Roman) for text.
- Use italics for emphasis.
- Use the automatic page numbering function to number the pages.
- Do not use field functions.
- Use tab stops or other commands for indents, not the space bar.
- Use the table function, not spreadsheets, to make tables.
- Use the equation editor or MathType for equations.
- Save your file in docx format (Word 2007 or higher) or doc format (older Word versions).

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Please use no more than three levels of displayed headings.

Abbreviations

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Footnotes can be used to give additional information, which may include the citation of a reference included in the reference list. They should not consist solely of a reference citation, and they should never include the bibliographic details of a reference. They should also not contain any figures or tables.

Footnotes to the text are numbered consecutively; those to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data). Footnotes to the title or the authors of the article are not given reference symbols.

Always use footnotes instead of endnotes.

Acknowledgments

Acknowledgments of people, grants, funds, etc. should be placed in a separate section on the title page. The names of funding organizations should be written in full.

Automatic Line Numbering function

You will find both the automatic numbering function for the pages and lines in the main under "function". You need to open the "document" and look for the layout.

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References

Citation

Reference citations in the text should be identified by numbers in square brackets. Some examples:

1. Negotiation research spans many disciplines [3].
2. This result was later contradicted by Becker and Seligman [5].
3. This effect has been widely studied [1-3, 7].

Reference list

The list of references should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text.

Reference list entries should be alphabetized by the last names of the first author of each work and numbered consecutively.

If available, please always include DOIs as full DOI links in your reference list (e.g. “https://doi.org/abc”).

Journal article

Gamelin FX, Baquet G, Berthoin S, Thevenet D, Nourry C, Nottin S, Bosquet L (2009) Effect of high intensity intermittent training on heart rate variability in prepubescent children. Eur J Appl Physiol 105:731-738.

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be accepted:

Smith J, Jones M Jr, Houghton L et al (1999) Future of health insurance. N Engl J Med 965:325–329

Article by DOI

Slifka MK, Whitton JL (2000) Clinical implications of dysregulated cytokine production. J Mol Med. https://doi.org/10.1007/s001090000086

Book

South J, Blass B (2001) The future of modern genomics. Blackwell, London

Book chapter

Brown B, Aaron M (2001) The politics of nature. In: Smith J (ed) The rise of modern genomics, 3rd edn. Wiley, New York, pp 230-257

Online document

Doe J (1999) Title of subordinate document. In: The dictionary of substances and their effects. Royal Society of Chemistry. Available via DIALOG. http://www.rsc.org/dose/title of subordinate document.

Accessed 15 Jan 1999

Always use the standard abbreviation of a journal's name according to the ISSN List of Title Word Abbreviations, see ISSN.org LTWA. If you are unsure, please use the full journal title.

DOI citation

Please note: The DOI has only to be added to the reference in case the cited manuscript has thus far just been electronically published and thus no issue, page and volume numbers.

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Please note that you may use Zotero or Sente as alternative reference management programs.

You may find the bybliographic styles and the access information on the right side of this page at "Additional Information"

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Tables

- Each table should be numbered and cited in sequence using Arabic numerals
- Should also have a title, no longer than 15 words, that summarises the whole table
- Should always be cited in text in consecutive numerical order
- Abbreviation used should be put in the legends
- Identify any previously published material by giving the original source in the form of a reference at the end of the table caption

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- Smaller tables can be pasted into the end of the document text file, in A4 portrait or landscape format. These will be typeset and displayed in the final published form of the article
- Larger datasets or tables too wide for a portrait page can be uploaded separately as additional files. Additional files will not be displayed in the final, laid-out PDF of the article, but a link will be provided to the files as supplied by the author.

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Artwork and Illustrations Guidelines

Electronic Figure Submission

- Supply all figures electronically.
- Indicate what graphics program was used to create the artwork.
- For vector graphics, the preferred format is EPS; for halftones, please use TIFF format. MSOffice files are also acceptable.
- Vector graphics containing fonts must have the fonts embedded in the files.
- Name your figure files with "Fig" and the figure number, e.g., Fig1.eps.

Line Art

- Definition: Black and white graphic with no shading.
- Do not use faint lines and/or lettering and check that all lines and lettering within the figures are legible at final size.
- All lines should be at least 0.1 mm (0.3 pt) wide.
- Scanned line drawings and line drawings in bitmap format should have a minimum resolution of 1200 dpi.
- Vector graphics containing fonts must have the fonts embedded in the files.

Halftone Art

- Definition: Photographs, drawings, or paintings with fine shading, etc.
- If any magnification is used in the photographs, indicate this by using scale bars within the figures themselves.
- Halftones should have a minimum resolution of 300 dpi.

Combination Art

- Definition: a combination of halftone and line art, e.g., halftones containing line drawing, extensive lettering, color diagrams, etc.
- Combination artwork should have a minimum resolution of 600 dpi.

Color Art

- Color art is free of charge for online publication.
- If black and white will be shown in the print version, make sure that the main information will still be visible. Many colors are not distinguishable from one another when converted to black and white. A simple way to check this is to make a xerographic copy to see if the necessary distinctions between the different colors are still apparent.

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Figure Lettering

- To add lettering, it is best to use Helvetica or Arial (sans serif fonts).
- Keep lettering consistently sized throughout your final-sized artwork, usually about 2–3 mm (8–12 pt).
- Variance of type size within an illustration should be minimal, e.g., do not use 8-pt type on an axis and 20-pt type for the axis label.
- Avoid effects such as shading, outline letters, etc.
- Do not include titles or captions within your illustrations.

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- All figures are to be numbered using Arabic numerals.
- Figures should always be cited in text in consecutive numerical order.
- Figure parts should be denoted by lowercase letters (a, b, c, etc.).
- If an appendix appears in your article and it contains one or more figures, continue the consecutive numbering of the main text. Do not number the appendix figures,"A1, A2, A3, etc." Figures in online appendices [Supplementary Information (SI)] should, however, be numbered separately.

Figure Captions

- Each figure should have a concise caption describing accurately what the figure depicts. Include the captions in the text file of the manuscript, not in the figure file.
- Figure captions begin with the term Fig. in bold type, followed by the figure number, also in bold type.
- No punctuation is to be included after the number, nor is any punctuation to be placed at the end of the caption.
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Accessibility

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- Patterns are used instead of or in addition to colors for conveying information (colorblind users would then be able to distinguish the visual elements)
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Submission

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resolution videos should not be larger than 5GB.

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- Minimum video duration: 1 sec
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Text and Presentations

- Submit your material in PDF format; .doc or .ppt files are not suitable for long-term viability.
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- This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of University B (Date…/No. …).
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Informed consent

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- Informed consent was obtained from legal guardians.
- Written informed consent was obtained from the parents.
- Verbal informed consent was obtained prior to the interview.

Sample statements for "Consent to publish"

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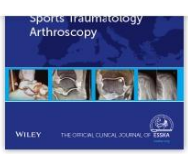

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