Four Strand versus Quadruple Semi Tendinosis - Does preparation technique have an influence on graft thickness in patients undergoing primary ACL reconstruction?

E.Donnelly, M. Kennedy, SJ. Spencer
Department of Trauma and Orthopaedic Surgery, Queen Elizabeth University Hospital, 1345 Govan Road, Glasgow, G51 4TF

Over the last two decades the incidence of ACL reconstruction increased from 2 per 100,000 to 24.2 per 100,000 patients. Graft re-rupture has been quoted as occurring in up to 10% of patients with revision reconstruction resulting in inferior clinical and patient related outcomes when compared with successful primary reconstruction[1].

Graft size <8mm in diameter has been associated with early rupture of up to 16.4% [2]. A larger graft diameter results in better load sharing reducing the risk of re-rupture.

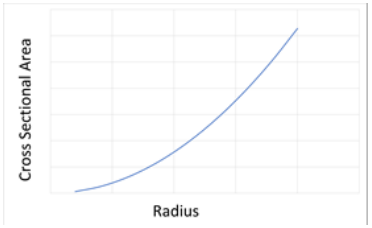

Figure 1: Relationship between radius and CSA.

As number of collagen fibers are dictated by cross sectional area (CSA), due to the squared relationship between these two values (Figure 1) even small relatively small increases in the radius of a graft result in a relatively large increase in CSA (Figure 2).

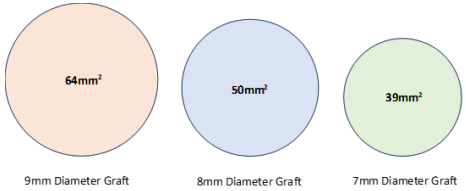

Figure 2: Comparison of CSA of 7mm, 8mm and 9mm grafts.

Methods

The electronic case notes of all male patients who underwent ACL reconstruction by a single surgeon in our unit were reviewed retrospectively.

Age, weight, height, BMI, graft preparation technique and graft size were recorded. The primary aim was to compare graft size in relation to type preparation technique used.

Exclusion criteria; female patients patients under age 16 at time of surgery, technique/graft size not recorded, revision/multi-ligament surgery or BTB grafts/allografts were excluded .

Surgical Technique

Grafts were prepared using either a 4-strand [3] or GraftLink technique (Quadrupling Semitendinosus) [4].

A 4-strand graft was prepared by harvesting both semitendinosus and Gracilis, and Whipstitching the ends and passing them through an ACL tightrope to create a four-core graft (figure 3).

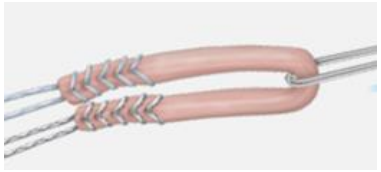

Figure 3: 4 Strand ACL graft with tightrope and whipstitch.

The GraftLink construct was created by harvesting only semitendinosus. The graft is then passed through two tightropes twice and the ends sutured together to create a four-core graft using one tendon (figure 4).

Figure 4: GraftLink contruct formed from SemiTendinosus.

Results

Overall 205 patients underwent ACL reconstruction between 05/10/2012 and 05/03/2020 (**Table 1**).

All Grafts (212)	**Mean (SD)**
Age	28.58 (8.06)
Height (m)	1.77 (0.07)
Weight (kg)	83.01 (12.60)
Body Mass Index	26.45 (3.56)

Table 1: Patient Demographics for all Grafts.

Of 212 patients, 160 (75%) were performed using a four Strand Technique. Average graft size by technique is demonstrated in Table 2.

	Median (IQ Range)
All Grafts	8.00 (7.50 – 8.50)
Four Strand	8.00 (7.50 – 8.50)
Quad Semi-T	9.00 (8.50 – 9.00)

Table 2: Comparison of Median graft size by technique.

Discussion

In our study of 212 male patients, median graft diameter favored the semitendinosus group with an average graft size of 9.00mm vs 8.00mm in the four-strand group.

Attempts have been made to predict graft size in relation to patient characteristics [5–8] with patient height and thigh length being the most statistically significant predictor of graft size.

Our data appeared to confirm this, with positive correlation between graft diameter and height followed by weight, there was no correlation seen with age.

Our re-rupture rate was 4.4% (8) overall and although not statistically significant, all but 2 patients had a graft diameter of 8mm or less intraoperatively and only 1 was a quadruple Semi-T graft.

Conclusion

Using the single Quadruple Semi Tendinosis graft technique enabled us to achieve a thicker average graft size than with the 4-strand technique.

Extrapolating from already published data on graft diameter and rupture rate, adoption of this as a standard technique for reconstruction might reduce re-rupture rates in patients undergoing primary ACL reconstruction.

[1]Abram SGF, Price AJ, Judge A, Beard DJ. Anterior cruciate ligament (ACL) reconstruction and meniscal repair rates have both increased in the past 20 years in England: hospital statistics from 1997 to 2017. Br J Sports Med 2020;54:286–91. [2]Magnussen RA, Lawrence JTR, West RL, Toth AP, Taylor DC, Garrett WE. Graft size and patient age are predictors of early revision after anterior cruciate ligament reconstruction with hamstring autograft. Arthroscopy 2012;28:526–31. [3]Frank RM, Hamamoto JT, Bernardoni E, Cvetanovich G, Bach BR, Verma NN, et al. ACL Reconstruction Basics: Quadruple (4-Strand) Hamstring Autograft Harvest. Arthroscopy Techniques 2017;6:e1309–13. [4]Lubowitz JH, Amhad CH, Anderson K. All-Inside Anterior Cruciate Ligament Graft-Link Technique: Second-Generation, No-Incision Anterior Cruciate Ligament Reconstruction. Arthroscopy: The Journal of Arthroscopic & Related Surgery 2011;27:717–27. [5]Goyal S, Matias N, Pandey V, Acharya K. Are pre-operative anthropometric parameters helpful in predicting length and thickness of quadrupled hamstring graft for ACL reconstruction in adults? A prospective study and literature review. International Orthopaedics (SICOT) 2016;40:173–81. [6]Treme G, Diduch DR, Billante MJ, Miller MD, Hart JM. Hamstring graft size prediction: a prospective clinical evaluation. Am J Sports Med 2008;36:2204–9. [7]Tuman JM, Diduch DR, Rubino LJ, Baumfeld JA, Nguyen HS, Hart JM. Predictors for hamstring graft diameter in anterior cruciate ligament reconstruction. Am J Sports Med 2007;35:1945–9. [8]Papastergiou SG, Stergios PG, Konstantinidis GA, Georgios KA, Natsis K, Konstantinos N, et al. Adequacy of semitendinosus tendon alone for anterior cruciate ligament reconstruction graft and prediction of hamstring graft size by evaluating simple anthropometric parameters. Anat Res Int 2012;2012:424158.