

How do We Manage an Insufficient Graft Diameter During Anterior Cruciate Ligament Reconstruction? Current Situation in Spain

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SUMMARY

Introduction: Anterior cruciate ligament (ACL) reconstruction is a very frequent surgery, hamstring autograft is one of the most commonly used grafts. Currently, it appears that graft diameter equal to or less than 8 mm has been associated with an increased risk of rupture. There is a lack of consensus as to how a small diameter graft is managed intraoperatively.

Objective: To know the current trend in our country regarding ACL augmentation techniques.

Material and Methods: Online survey sent from the Spanish Arthroscopy Association (AEA) to all its members.

Results: 187 answers were obtained (14.38%). A total of 38.2% of surgeons always performed some augmentation technique. 45.9% prepared the graft in more than 4 fascicles, 16.7% used other techniques, 13.4% used fascia lata, 8.6% used quadricipital tendon or no technique and 7% used hybrid auto-allograft. Synthetic material was added in 12.4%, biological augmentation in 5.3% and anterolateral reinforcement in 29.9%.

Conclusion: Currently, there is no consensus in our country regarding the intraoperative management of a hamstring graft equal to or less than 8 mm. In general, the current tendency is to prepare the graft in more than 4 fascicles. More studies are needed to know which is the most recommended technique.

Introduction

Isolated anterior cruciate ligament (ACL) tear is a common injury, with an annual incidence of 68.6 per 100,000 population in the USA [1]. Currently, about 200,000 surgeries are performed annually in the USA and about 400,000 worldwide [2]. The hamstring autograft prepared in four fascicles represents a very reproducible option for ACL reconstruction. Different studies have shown an increased risk of

rupture if the diameter of the graft does not exceed 8 mm, but there is no consensus as to which technique might be more suitable for predicting the diameter of the graft [3-7]. For this reason, numerous techniques have been described to increase the diameter of the graft intraoperatively, which reflects the lack of consensus in the management of insufficient grafts. The aim of our work was to know the current trend in our country regarding the techniques used to augment a hamstring graft with a diameter equal to or less than 8mm.

Material and Methods

After the literature review we conducted a 10-question survey that was sent via email through the Spanish Arthroscopy Association (AEA) to all its members from May 1, 2021 to July 1, 2021. The title of the survey was "ACL Augmentation Survey" and the questions and answers were as follows:

1. Graft often chosen: Hamstring autograft, BTB, quadriceps tendon, allograft or other grafts.
2. Technique used: Anatomic, all inside, transtibial or other.
3. With what frequency do you obtain hamstring grafts of less than 8 mm: 0-25%, 25-50%, 50-75% or 75-100%.
4. In case of obtaining a hamstring graft less than 8 mm, do you perform any additional maneuver?: Always, sometimes, never or depending on the type of patient.
5. In case of using hamstring grafts, what is your usual way of preparation? Semitendinosus in 4 fascicles, semitendinosus + internal rectus in 4 bands, semitendinosus + internal rectus in more than 4 fascicles or I do not use hamstrings.
6. What is your preferred technique to perform an augmentation in a graft that you consider not enough? Quadriceps tendon, fascia lata, hybrid allo + autograft, preparation in more

than 4 fascicles, none or other.

7. Do you add any type of synthetic material?: Yes or no.
8. If the previous answer is YES, what material: The surgeon was given the option to write the synthetic material used.
9. Do you perform biological augmentation (exclusively to obtain an insufficient graft, not in other indications): No; yes, with growth factors; yes, with mesenchymal cells or yes, others.
10. Do you perform augmentation by anterolateral reinforcement (exclusively for obtaining an insufficient plasty, not in other indications): Yes or no.

A total of 1300 surveys were sent out. With the results obtained, a descriptive analysis was performed to observe trends in the ACL augmentation in Spain and to extract the most representative characteristics of the data set. The statistical study was performed using the SPSS statistical package and the w2 test or Fisher's exact test were applied as appropriate.

Results

A total of 187 answers (14.38%) were obtained, which are summarized in Figures 1-10.

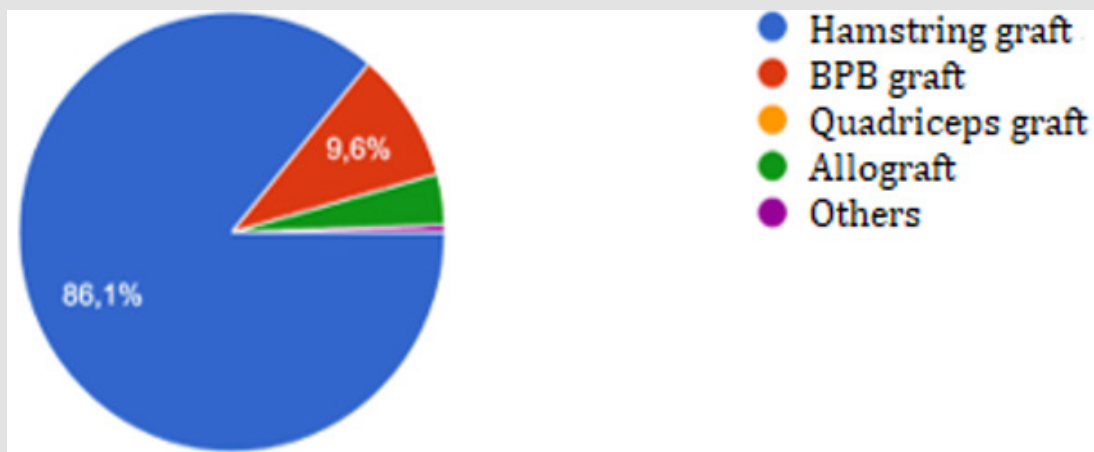


Figure 1: Graft of common choice.

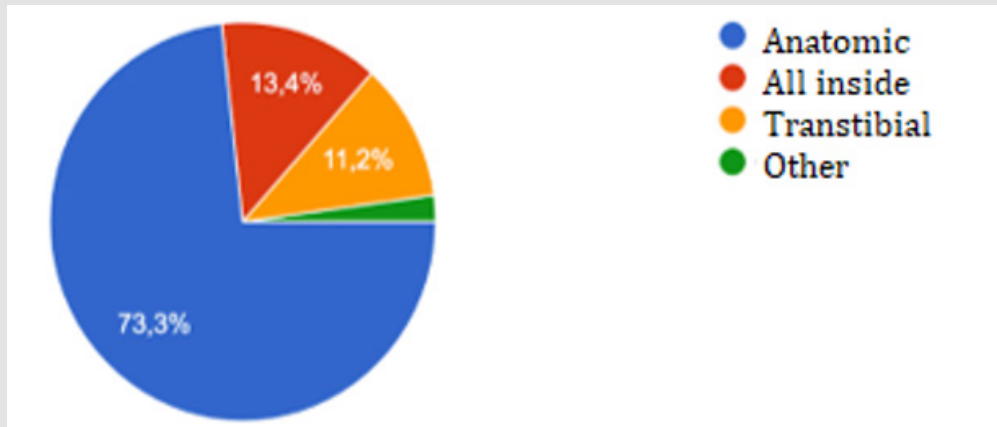


Figure 2: Technique used.

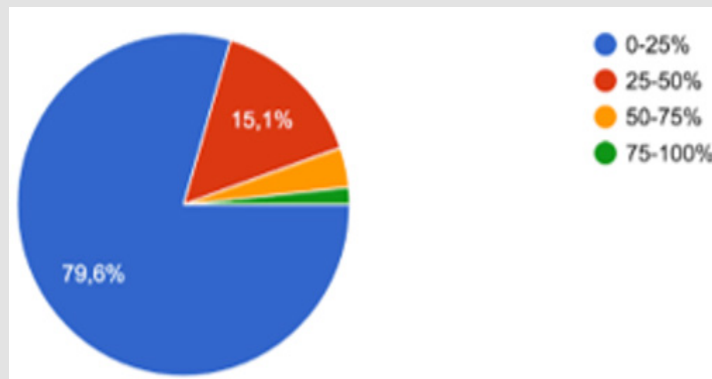


Figure 3: Approximately how often do you obtain hamstring grafts equal to or smaller than 8.

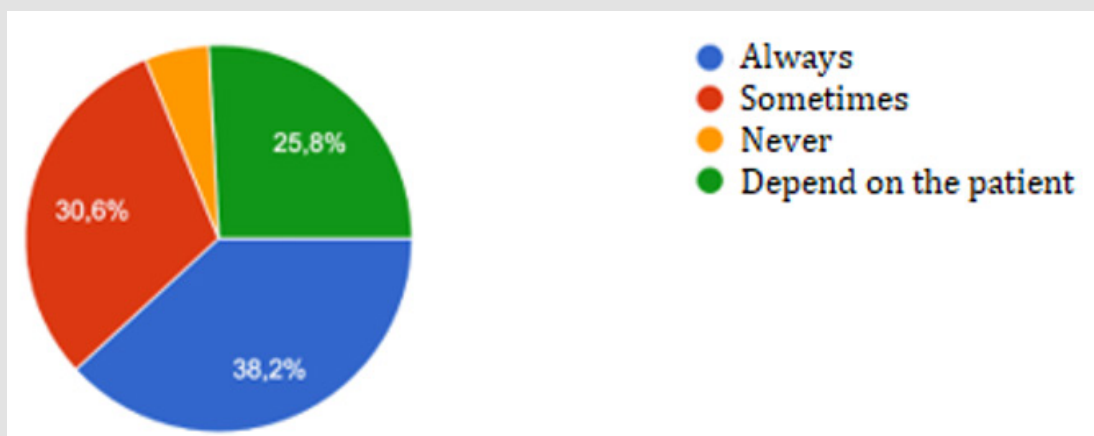


Figure 4: In case of obtaining a hamstring graft of less than 8 mm, do you perform any additional procedure?.

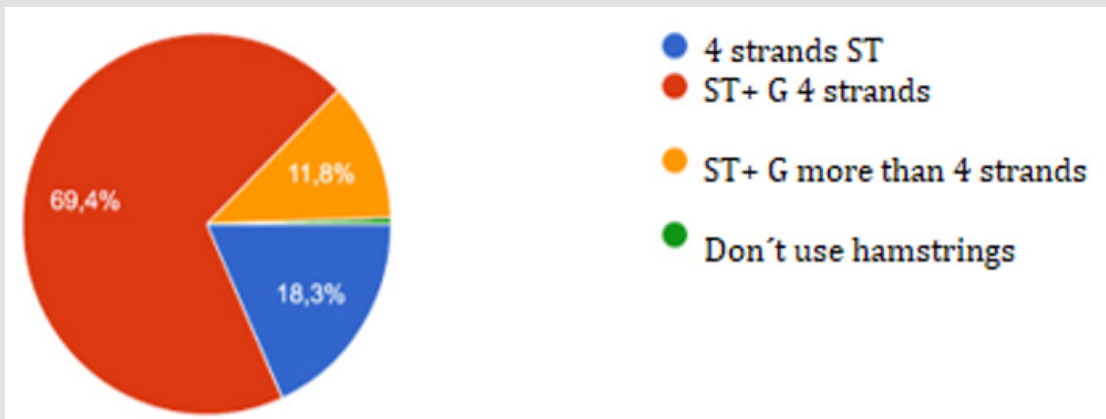


Figure 5: In case of using hamstring grafts, what is your usual way of preparation?.

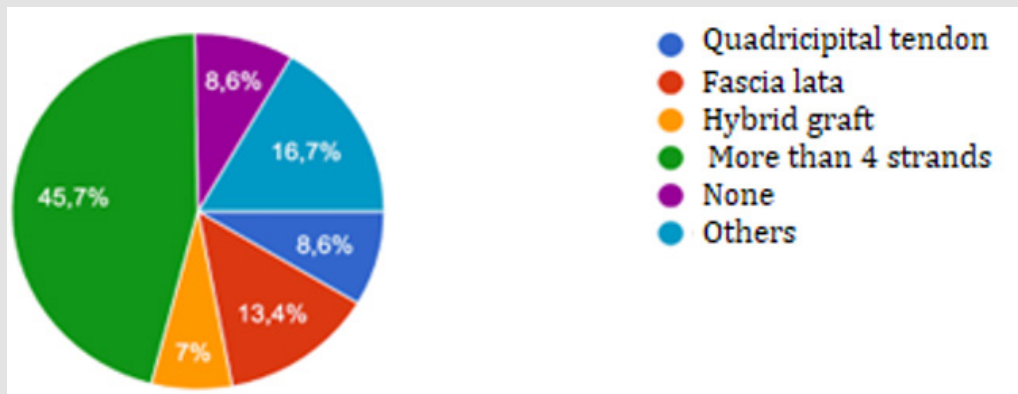


Figure 6: What is your preferred technique for performing an augmentation on a graft that you consider not enough?.

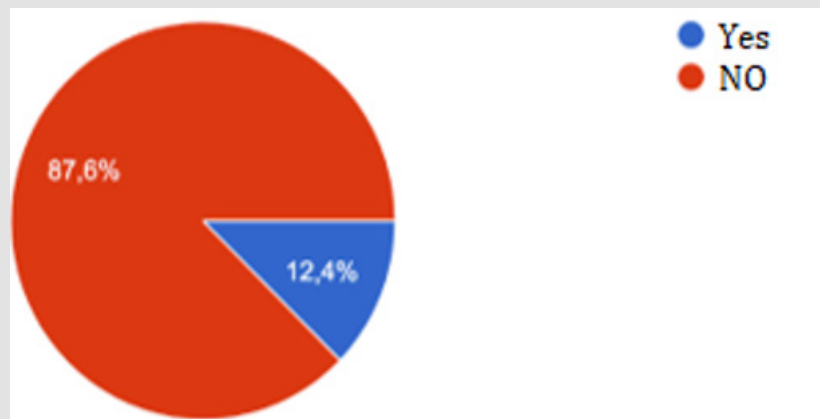


Figure 7: Do you add any type of synthetic material?.

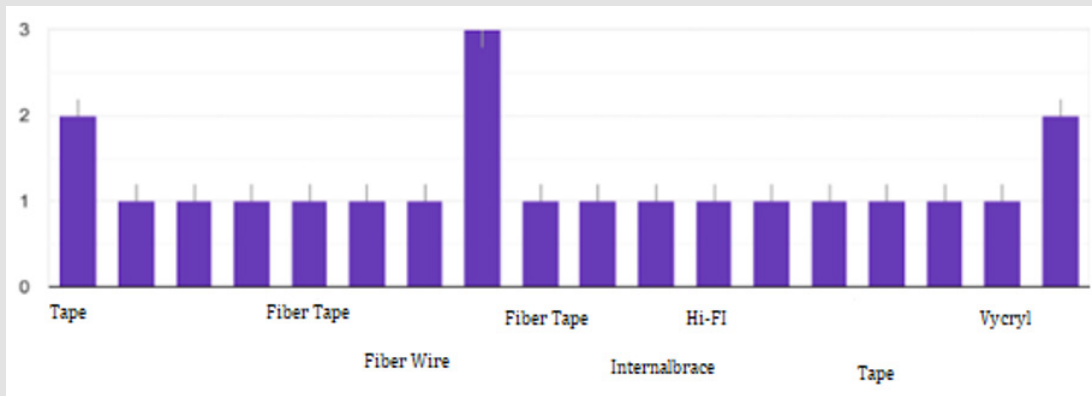


Figure 8: If the answer above is YES, which material?.

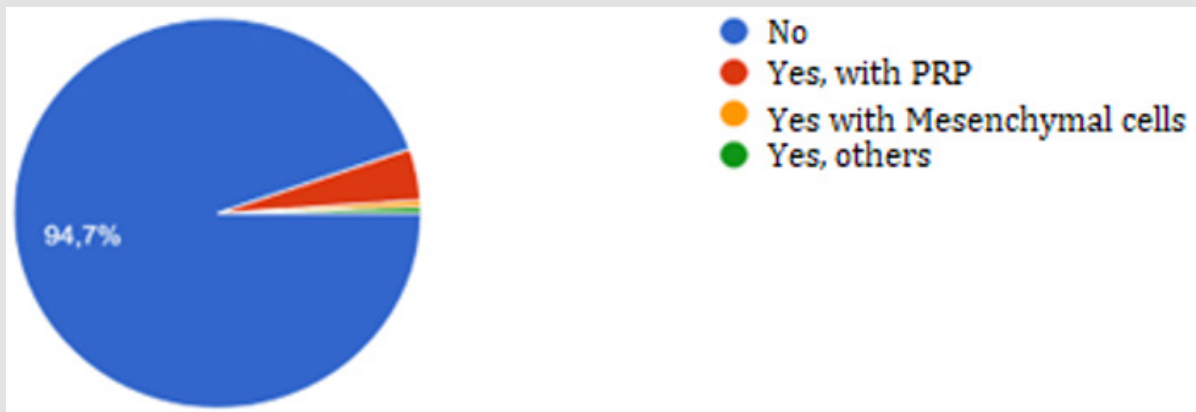


Figure 9: Do you perform biological augmentation (exclusively for obtaining an insufficient graft, not for other indications)?.

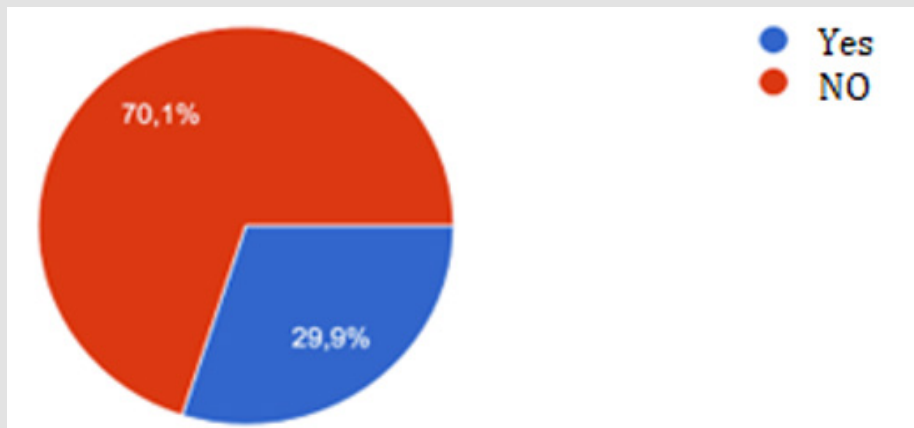


Figure 10: Do you perform augmentation by anterolateral reinforcement (exclusively for obtaining an insufficient graft, not in other indications)?.

Discussion

The most relevant finding of our survey was that despite the fact that ST-RI autograft graft was the most used (86.1%), only 38.2% of surgeons always associated some technique to increase the diameter in case it was equal to or less than 8mm. Conte et al. in their systematic review in 2014 concluded that the use of hamstring autograft in four fascicles with a diameter greater than 8mm decreased the risk of failure, even in patients younger than 20 years [6]. Rahardja et al. performed in 2020 a review of registries on risk factors for reoperation after ACL reconstruction surgery. Regarding the diameter of the graft, one of the Swedish registries reported 0.86 times less likelihood of revision for every 0.5 mm increase in diameter [7]. Even with these data, probably the lack of consensus means that many surgeons do not add any additional gesture to increase the diameter, or that we do not know when they do it. A possible explanation is that it was decided not to increase in patients with low functional demand or of the female sex, where it has been demonstrated in anatomical studies that the cross-sectional area, length and volume of the ACL are smaller in size [8].

Another of the most interesting aspects was the great variety of techniques used to perform augmentation, the most commonly used being the preparation of the graft in more than 4 fascicles (45.9%). The use of hamstring autograft in 5 fascicles is a simple and economical technique, involving only slightly more time in its preparation [9]. Amini et al. published a surgical technique in 2017, in which they prepared the graft in 5 fascicles and added a fibrin clot, they concluded that their technique had the potential to improve outcomes and decrease graft failure [9]. However, Krishna et al. compared 4- and 5-fascicle graft at 2-year follow-up, and although the latter clearly increased the diameter, they found no significant improvement [10]. The second most voted response was "other" (16.2%). Samitier et al. published in 2019 a braid-shaped graft preparation technique, they referred that increases the diameter by approximately 1 mm, at the expense of shortening it by about 5-10 mm; this configuration seems to reproduce the native shape of the ACL and could resemble it in its mechanical behavior [11]. Another augmentation technique would be the all inside technique, which uses the semitendinosus in 4 bands and increases the diameter of the graft while decreasing the length of the bone tunnels [12]. The next most commonly used techniques were augmentation with another type of autograft, with fascia lata (13.5%) and with quadriceps tendon (8.6%).

Espejo-Reina et al. published a surgical technique of ACL reconstruction augmented with fascia lata and anterolateral tenodesis. The advantages were to be able to perform an anatomical technique and augment the ACL without damaging another autograft area, without adding allograft or artificial material and using a single femoral tunnel for the ACL and for the anterolateral tenodesis [13]. ACL augmentation with quadriceps tendon has the advantages of not hav-

ing to add allograft or synthetic material and being able to extract it from the ipsilateral knee, although morbidity is added due to the use of a new autograft. According to a biomechanical study comparing hamstring grafts and augmented grafts with quadriceps tendon of the same diameters (between 8 and 10.5 mm), augmented grafts achieved a biomechanical behavior similar to hamstring grafts [14]. Only 7% of surgeons used hybrid grafts (allo-autograft). Pennock et al compared small diameter grafts with larger hybrid grafts in teenagers, and concluded that adolescents tend to have smaller diameters, but that allograft augmentation did not reduce the risk of failure, but even increased rupture and led to earlier failure [15]. Xu et al performed revision arthroscopies 2 years after ACL reconstruction with hamstring and hybrid grafts, found statistically significant results in terms of synovialization and graft tension in favor of the autograft, They argued that although the diameter of the graft and the 60-80% occupation of the anatomical footprint are factors that influence the success of the technique, a homogeneous autograft obtains superior results, both clinically and on arthroscopic evaluation, to hybrid grafts of the same diameter [16].

However, Rao et al, performed a retrospective review of their ACLs operated on between 2005 and 2015, comparing 59 patients with hybrid grafts to 80 patients with hamstring autograft, found no significant differences in terms of rerupture or reoperation. The allograft they used was sterilized with low doses of gamma irradiation, and they argued that all the studies that obtain negative results from the use of hybrid grafts use irradiated allografts, which have been shown to be inferior to non-irradiated ones [17]. Very few surgeons added synthetic material (12.4%) and what they used in most cases was a high-strength tape (72.72%). The exclusive use of synthetic material is in disuse due to the number of early failures and synovitis produced [18], although it has been seen that new generation materials can achieve similar results to autografts, both in their exclusive use and by augmenting an autograft [19,20]. Hamido et al reviewed 112 patients who underwent ACL reconstruction with hamstring autograft augmented with Ligament Augmentation and Reconstruction System (LARS [®]), obtained good results at 5 years of follow-up, being a useful, safe and satisfactory therapeutic option in those cases with insufficient grafts [21]. One out of every three surgeons added an anterolateral brace.

This technique associated with ACL reconstruction contributes to the control of rotational instability and decreases the stress of the graft, which is reflected in better clinical results, reducing residual pivot shift and reruptures [22-24], but there are no articles that review its use in case of insufficient graft. Biological augmentation in ACL reconstruction is not very widespread in our environment (5.4%), most articles talk about the integration of the graft and ligamentization using growth factors, but not about its usefulness in case of insufficient diameter graft, even so, there is no evidence to recommend its use and more studies are needed [25,26]. Finally, the

anatomic technique was the most commonly used, with only 11.2% of surgeons performing the transtibial technique. A clear change has been reflected with respect to the previous trend, in the work of Pelfort et al. on the situation in ACL reconstruction in Spain in 2010, 74% of surgeons chose the transtibial technique as their technique of choice [27]. One of the main limitations of the study was the percentage of answers obtained. The survey was sent through the AEA to all its members (1300) and 187 responses were obtained, which is 14.38%. Duquin et al, in a survey conducted on ACL reconstruction to members of the American Orthopaedic Society for Sports Medicine (AOSSM) obtained a response rate of 57% [28]. Pelfort et al. in their nationwide survey obtained a response rate of 30.7% [27]. Our low response rate may be due to the fact that only a portion of the AEA members perform knee arthroscopy.

Conclusion

Currently, there is no consensus in our country regarding the intraoperative management of a hamstring graft equal to or smaller than 8 mm. This lack of consensus is observed not only in the indication for augmentation graft, but also in the technique used for it. More studies are needed to know which technique is the most recommended.

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