

CRITERIA FOR USE OF SUPRACONDYLAR AND SUPRACONDYLAR—SUPRAPATELLAR SUSPENSION FOR BELOW-KNEE PROSTHESES

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A number of articles have been published on the "PTS" or a variation. Supracondylar with suprapatellar suspension has been described by several authors (2, 5, 6). A method of medial brim supracondylar suspension (1), a medial supracondylar wedge suspension (3), and a detachable medial brim suspension (4) have also been described. All these articles have reported a high incidence of success with their particular approach.

I began using the "PTS" approach in late 1967 and have fluctuated between supracondylar plus suprapatellar suspension and supracondylar suspension alone. Because, when both methods were tried on the same patient one method was preferred to the other, study was initiated to determine which was the method of choice in meeting the suspension needs of the below-knee amputee.

Careful analysis of changes of the stump-thigh relationship determined by measurement, combined with subjective information gained from patients having worn both suspension types, led to the grading system to be presented here.

GRADING SYSTEM

For determining the mode of suspension for a BK prosthesis, a grading system has been developed and used. The system uses 0 to 2 points allowance per category. There are six categories, two major and four minor. The distribution of points is given in Table 1.

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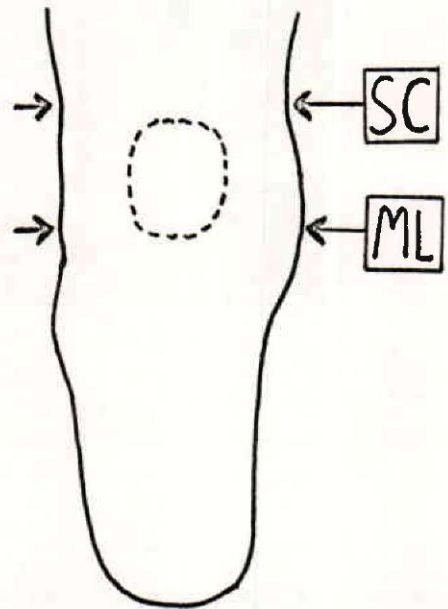


Fig. 1. Diameter measurements at the supracondylar (S/C) and mediolateral (M/L) knee levels.

Major Category:

1. Relationship between the diameters of the mediolateral (M/L) knee measurement and supracondylar (S/C) measurement (Fig. 1).
2. Relationship between the circumferential measurement at the patellar tendon (P/T) level and at the supracondylar (S/C) level (Fig. 2).

GRADING SYSTEM

		SUPRACONDYLAR	SUPRACONDYLAR PLUS SUPRAPATELLAR
MAJOR			
1. ML/SC	Difference between		
	1 inch or less	0	2
Diameter	1 1/8 inch to 1 1/2 inch	2	1
	Greater than 1 1/2	0	2
2. PT/SC	S/C circ: P/T circ:		
	Larger Smaller	0	2
Circumference	Equal Equal	2	1
	(within 1/2 inch)		
	Smaller Larger		0
MINOR			
1. Stump Length:			
	Less than 3"	0	2
	Between 3" to 4 1/2"	1	2
	Greater than 4 1/2"	0	0
2. Prominent Rectus Femoris Tendon		2	0
3. Desirability of Full Knee Extension		2	0
4. Knee Flexion Contracture		0	2
5. Bilateral B/K Amputee		0	2
6. Cosmetic Factor		0	2

TABLE 1.

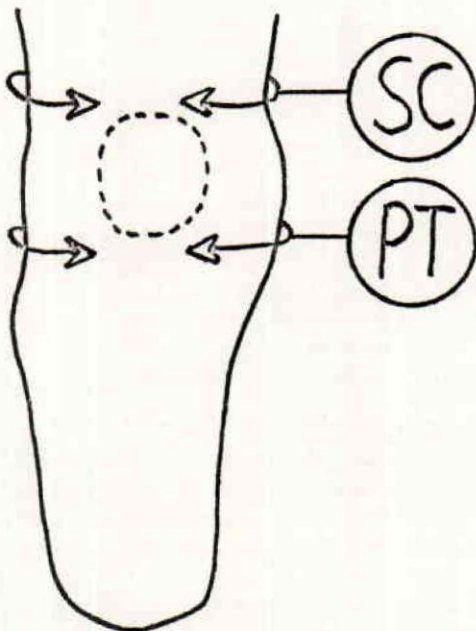


Fig. 2. Circumferential measurements at supracondylar (S/C) and patellar tendon (P/T) levels.

Minor Category:

1. Stump length
2. Prominence of rectus femoris tendon
3. Patients' desirability of full knee extension
4. Presence of knee flexion contracture
5. Bilateral B/K amputation
6. Cosmesis

The rationale for a major and a minor category is based on a relationship between the stump and thigh. The two determinants of the major category are directly related to the measurements of both structures. I have found that this measurement relationship largely determines the mode of suspension (Table 2). The determinants of the minor category which are not related to the stump-thigh measurement relationship can influence the suspension choice (Table 3).

MAJOR CATEGORY

Grading points are allotted in favor of one suspension method or the other (Table 1) depending on the measurement difference between the ML/SC relationship and the PT/SC circumference.

	SUPRACONDYLAR	SUPRACONDYLAR PLUS
MAJOR:		
1. S/C: $3\frac{1}{4}$ "		
M/L: 4 "	0	2
Difference: $\frac{3}{4}$ "		
2. S/C: $15\frac{1}{2}$ "		
P/T: 14 "	0	2
Difference: $1\frac{1}{2}$ "		
MINOR:		
1. Length: $6\frac{1}{2}$ "		
2. No		
3. No		
4. No		
5. No		
6. No		
TOTAL	0	4 POINTS

TABLE 2.

The knee M/L is measured at the widest point of the knee joint in the mediolateral plane. A measurement from a point just above the insertion of the adductor magnus muscle medially, (adductor tubercle) to the ilio-tibial band laterally defines the S/C diameter (Fig. 1).

Circumferential measurements are taken at the same level as the S/C diameter measurement, and at the patellar tendon level in line with the anatomical knee joint (Fig. 2).

In reference to Table 1, the reason for favoring supracondylar plus suprapatellar (PTSPC) suspension when the difference between the M/L and S/C measurement is 1 inch or less relates to the S/C circumference which usually is larger than the P/T's circumference (second determinate major category) in these cases. With this stump-thigh relationship, the thigh tapers towards the stump with extra subcutaneous tissue found in the supracondylar region (Fig. 3a). In this situation the addition of the suprapatellar brim increases suspension area from soft tissue as well as underlying bone structure.

In cases of ML/SC relationship greater than $1\frac{1}{2}$ inches with a S/C circumference smaller than a P/T circumference (Fig. 3c). I have found this

type of stump-thigh relationship presents a socket donning problem. Use of a two-piece socket consisting of a semi-flexible liner which can be donned and then inserted into a rigid receptacle has overcome this problem (1). The socket is fitted less intimately in the S/C region and additional suspension is gained from the area above the patella. Fillauer's detachable medial brim (4) would also solve this donning problem.

In the above two situations a 0 to 2 point allotment is made but in the ML/SC of $1\frac{1}{8}$ inch to $1\frac{1}{2}$ inch and in the PT/SC of equal (within a $\frac{1}{2}$ inch) the grading is 2 to 1. I have found that this group tends to prefer the supracondylar (PTSC) suspension but have managed on a PTSPC with little or no difficulty.

MINOR CATEGORY

Stump Length. The addition of the suprapatellar socket brim to supracondylar suspension offers the shorter B/K stump ($4\frac{1}{2}$ inches and less) support during stance in the forward direction as well as to act as a check to hyperextension at the knee joint. As shown in Table 1, a long stump is not biased in favor of either suspension method.

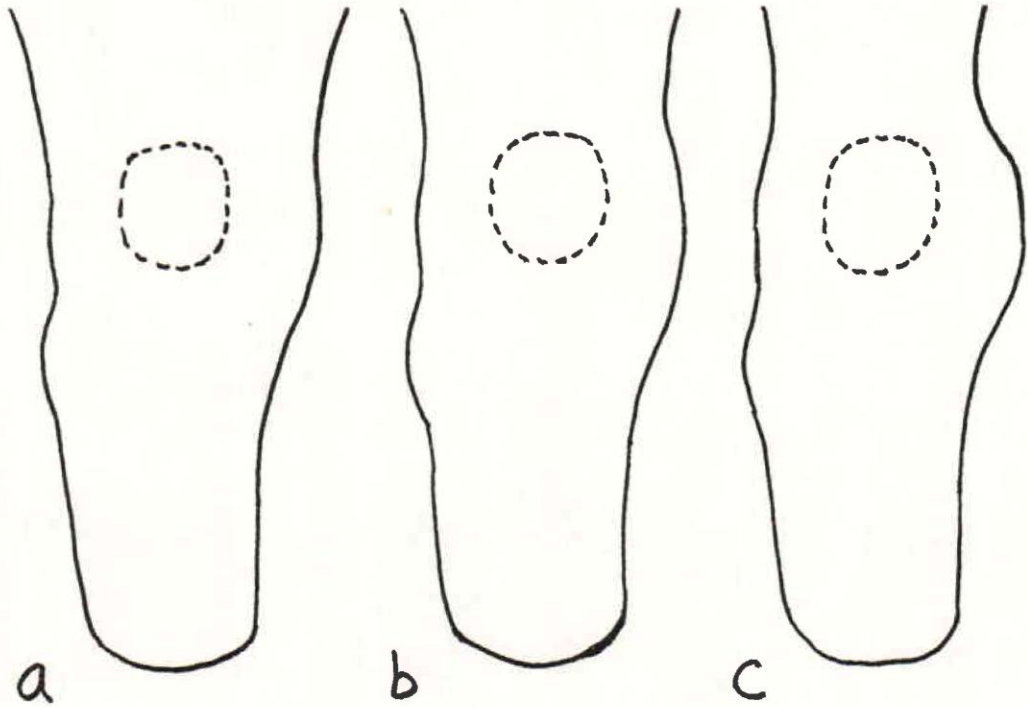


Fig. 3. The shapes of various stump-thigh relationships.

- a) The difference between the M/L and S/C circumference is larger than the P/T circumference.
- b) The difference between the M/L and S/C diameters is between $1\frac{1}{8}$ inch and $1\frac{1}{2}$ inch, and the S/C circumference is equal to the P/T circumference.
- c) The difference between the M/L and S/C diameters is greater than $1\frac{1}{2}$ inch, and the S/C circumference is smaller than the P/T circumference.

Prominent Rectus Femoris Tendon. If the patient has a prominent tendon, he may complain of discomfort by the suprapatellar brim. A prominent tendon scores high in favor of supracondylar suspension. No points are allotted to either suspension method if the tendon is not prominent. This determinant alone should not bias suspension choice, especially if more points are in favor of supracondylar plus suprapatellar. The suprapatellar brim depth can always be reduced. In the case of a tie in points I have found more success in choosing supracondylar suspension.

Desirability of Full Knee Extension. Two points are allotted in favor of supracondylar suspension, in the case of a former prosthetic wearer who desires unresisted full knee extension. The suprapatellar brim can be an annoyance to these patients. Re-education of the patient's knee joint control and/or a less prominent brim has often solved this problem in cases where suprapatellar brim was indicated.

Knee Flexion Contracture. A two point allotment to the addition of suprapatellar brim is made

in cases of apparent uncorrectable knee flexion contracture. The top edge of the patella offers a good suspension area, especially if the tissues are on the lean side and the patella is prominent. No points are allotted when a contracture is not present.

Bilateral B/K Amputee. These amputees normally maintain slight flexion of the knee while standing and during walking. This presents a situation similar to knee flexion contracture and two points are given in favor of the suprapatellar brim addition, because the brim augments stump support in stance in the forward direction, and acts as a check to full knee extension.

Cosmesis. Patients often prefer addition of the suprapatellar brim when considering cosmesis. In these cases the cosmetic factor indicates 2 points towards addition of the brim.

CLINICAL EXPERIENCE

During the past $3\frac{1}{2}$ years a total of fifty-two patients have been fitted at the Eastern Ontario Rehabilitation Centre with supracondylar and

	SUPRACONDYLAR	SUPRACONDYLAR PLUS SUPRAPATELLAR
MAJOR:		
1. S/C: $2\frac{5}{8}$ "		
M/L: $3\frac{7}{8}$ "	2	1
Difference: $1\frac{1}{4}$ "		
2. S/C: $12\frac{3}{4}$ "		
P/T: 12 "	0	2
Difference: $\frac{3}{4}$ "		
MINOR:		
1. Length: 5"		
2. Yes	2	0
3. Yes	2	0
4. No		
5. No		
6. No		
TOTAL	6	3 POINTS

TABLE 3.

supracondylar plus suprapatellar suspension. This time period has allowed follow up and re-fitting (due to stump shrinkage) of a large number of these cases.

Supracondylar suspension was used on 21 patients. Those fitted with supracondylar plus suprapatellar totaled 31. Three of the 31 were bilateral cases.

Of the patients re-fitted due to stump shrinkage, 18 continued with the original suspension type. Six changed from supracondylar plus suprapatellar suspension to supracondylar, and eight others altered suspension type in just the reverse. In all cases, maintaining or changing the suspension modality was supported by the criteria and reinforced by patient acceptance.

SUMMARY

A grading system for assisting in deciding between supracondylar or supracondylar-plus-suprapatellar suspension has been presented. The grading system offers points in favor of one type of suspension or the other. Point allotment is based upon measurement relationship be-

tween the thigh and BK stump, and also on subjective information obtained from the amputee.

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