Development of a new technique to evaluate abrasiveness of artificial turf

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Introduction and Objective

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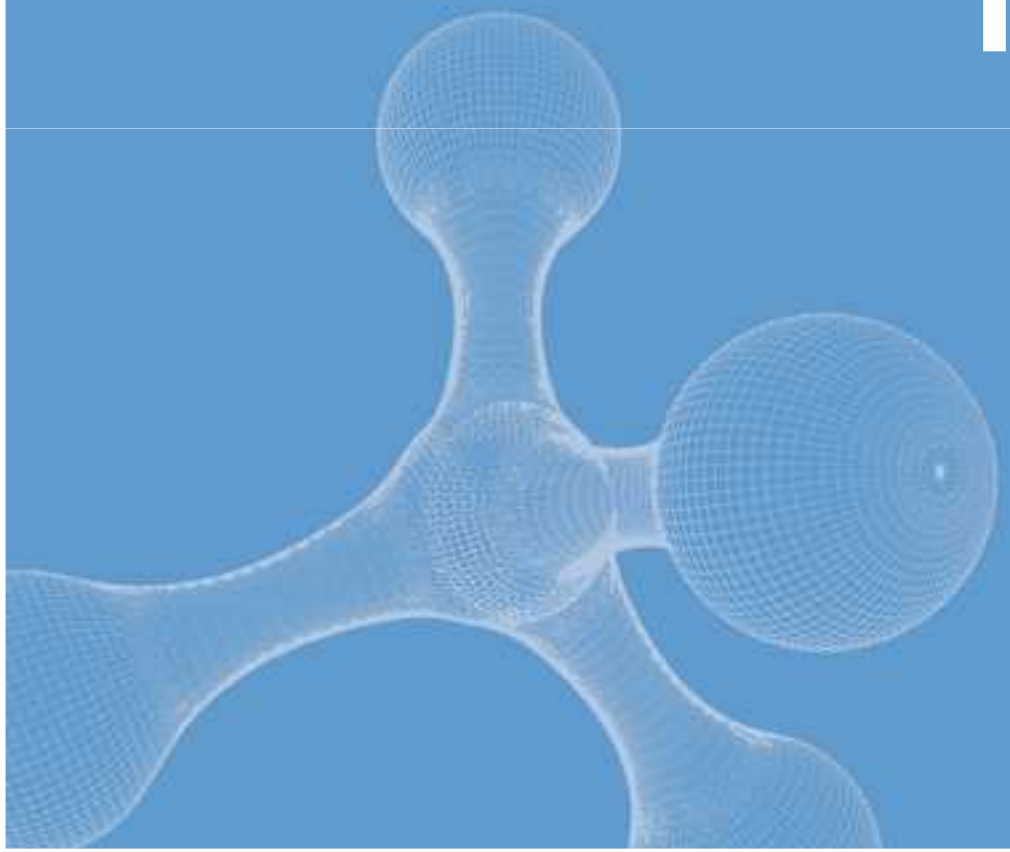
• There are several studies comparing risk of injury on artificial turf and natural grass, mainly regarding the risk of injury in ankle and knee

• However, an important problem of artificial turf (turf-burns) has not been studied in depth

• The test device currently used to measure abrasiveness on artificial turf does not reproduce the real sliding of sportsman

OBJECTIVE: to develop a new technique to evaluate abrasiveness of artificial turf

Materials and Methods



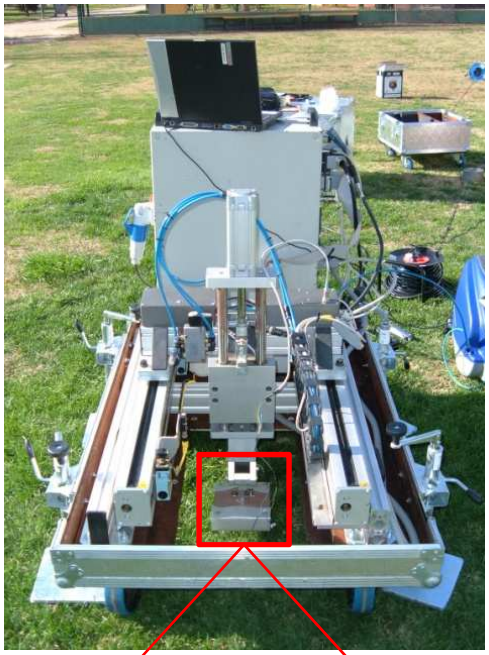
Materials and Methods

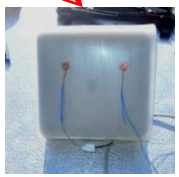
Study of sliding trackle

Develop of a test method

Test artificial turf samples

Validate of test results





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Materials and Methods

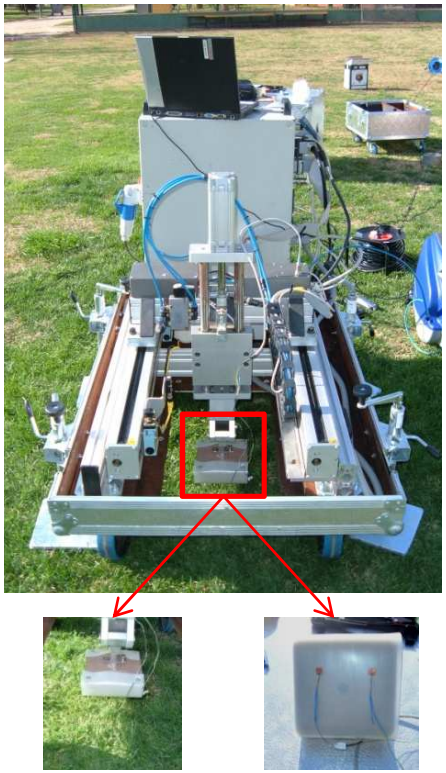
Study of sliding trackle → Develop of a test method → Test artificial turf samples → Validate of test results



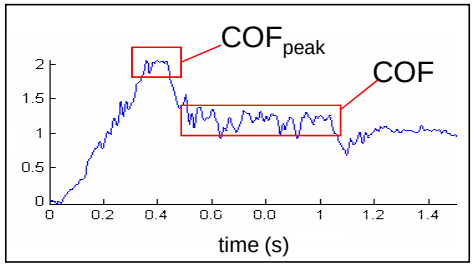
- Biomechanical tests were carried out in the laboratory
- High speed cameras and force platform were used
- Vertical force and velocity of sliding were obtained

Materials and Methods

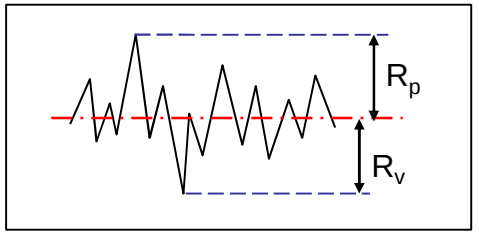
Study of sliding trackle → Develop of a test method → Test artificial turf samples → Validate of test results



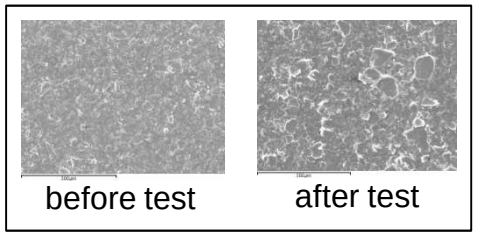
- From mechanical test, COFpeak and COF were obtained:
  - COFpeak possibly related to abrasion
  - COF possibly related to a rise of temperature



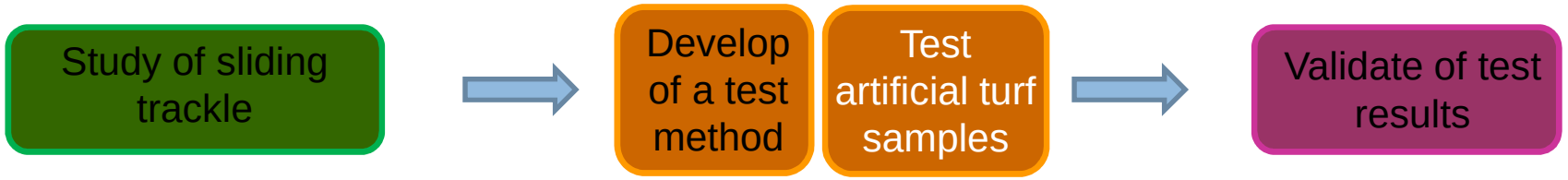
- Changes of roughness were evaluated in silicone:
  - Rp: maximum peak of roughness
  - Rv: minimum valley of roughness



- Changes in appearance were evaluated by means of Scanning Electron Microscopy



Materials and Methods



• Six artificial turf samples (without infill) were evaluated:

	Stitches (per 10 cm)	Dtex	Fibre material	Type of fibre	Pile height (mm)
A	17	11000	poliethylene1	fibrilated	60
B	17	11000	poliethylene2	fibrilated	60
C	15	12500	poliethylene1	fibrilated	60
D	17	11000	poliethylene1	monobench	60
E	17	11000	poliethylene2	monobench	60
F	17	11000	poliethylene3	monobench	60

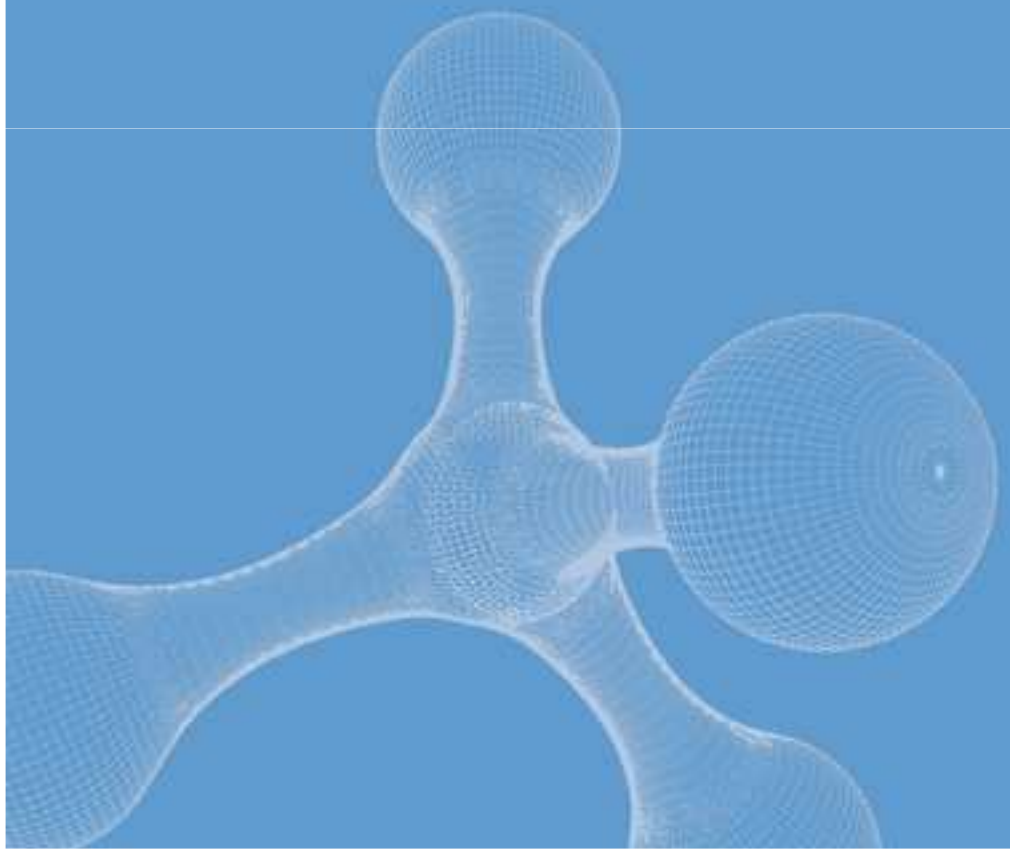
• Friction tests and evaluations of changes in the silicones were carried out on all the samples

Materials and Methods

Study of sliding trackle → Develop of a test method → Test artificial turf samples → Validate of test results

- A subjective study was carried out
- Five people participated in the study
- They rubbed their forearm against artificial turf carpets and answered several questions about abrasion perception
- After that an Analytic Hierarchy Process (AHP) (two-way comparison of artificial turf samples by means of forearm rubbing) was carried out
- A correlation between mechanical tests and subjective study results was obtained

Results

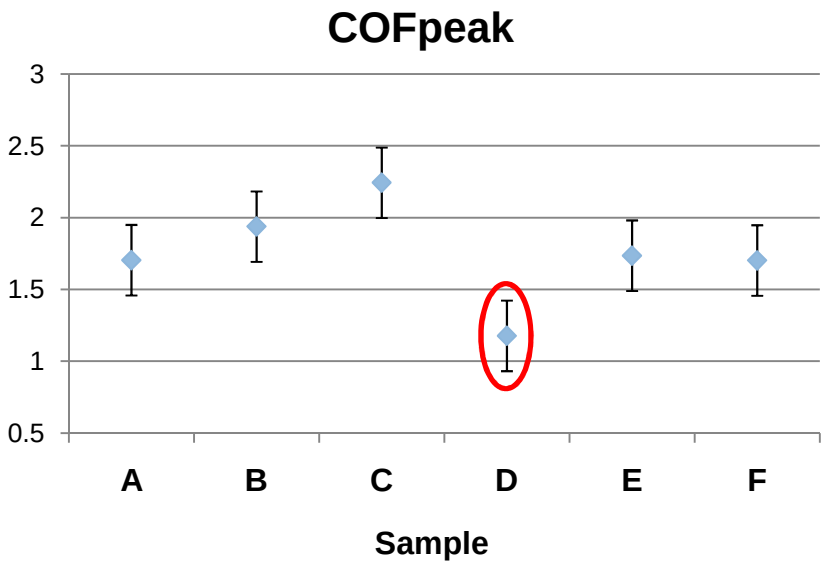


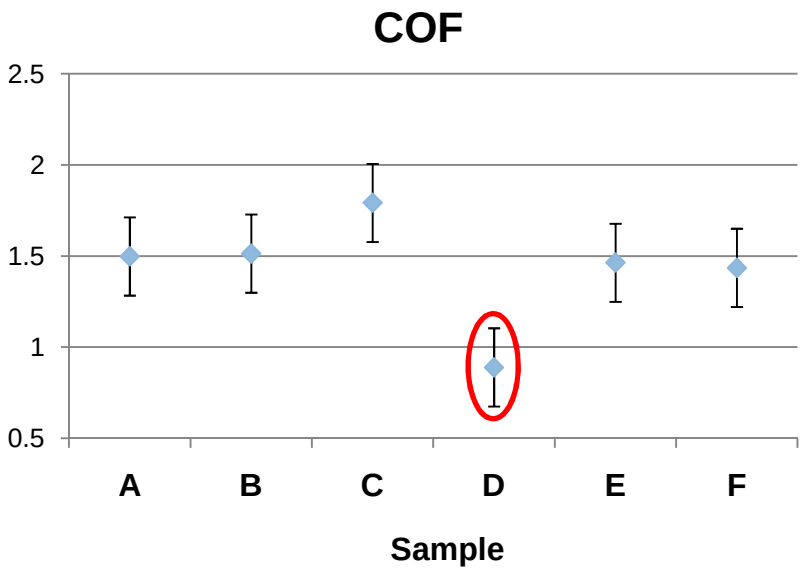
Results

- Nine sliding tests on each one of the six carpets were carried out

- Sample D showed the lowest coefficient of friction in comparison with the rest of samples (significant differences ($p<0.05$))

	Stitches (10 cm)	Dtex	Fibre material	Type of fibre	Pile height (mm)
A	17	11000	PE1	fibrilated	60
B	17	11000	PE2	fibrilated	60
C	15	12500	PE1	fibrilated	60
D	17	11000	PE1	monobench	60
E	17	11000	PE2	monobench	60
F	17	11000	PE3	monobench	60





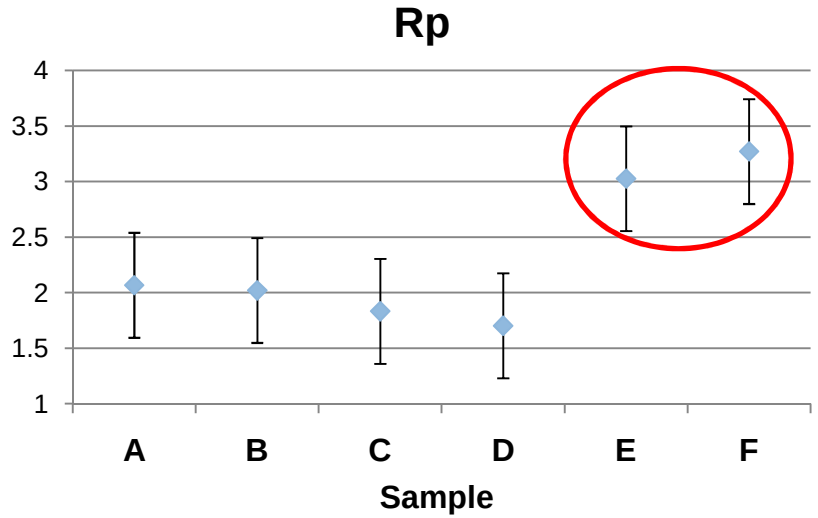
Results

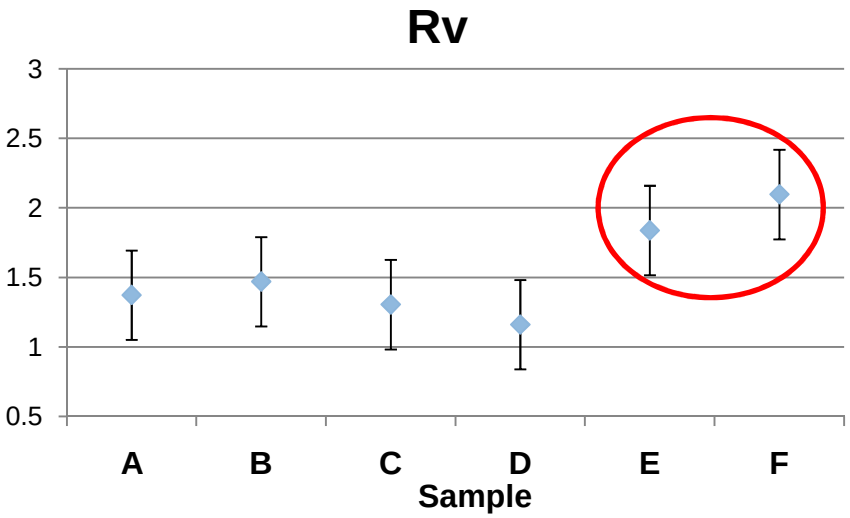
- Three silicones were obtained from each carpet to analyse the damage after the sliding test

- The roughness was measured and Rp and Rv values obtained

- Samples E and F showed significant differences in comparison with the rest of samples ($p<0.05$)

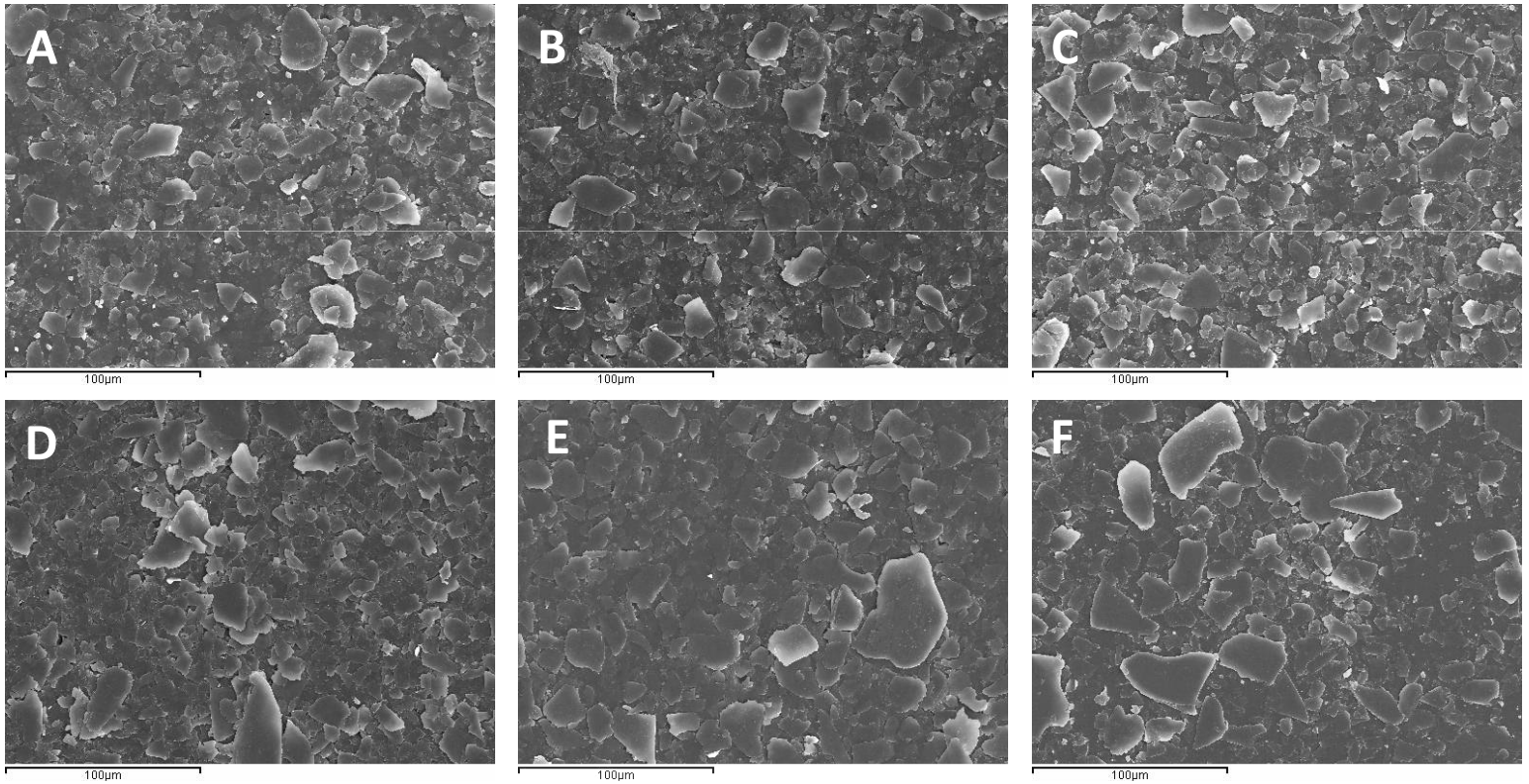
	Stitches (10 cm)	Dtex	Fibre material	Type of fibre	Pile height (mm)
A	17	11000	PE1	fibrilated	60
B	17	11000	PE2	fibrilated	60
C	15	12500	PE1	fibrilated	60
D	17	11000	PE1	monobench	60
E	17	11000	PE2	monobench	60
F	17	11000	PE3	monobench	60





Results

• Image analysis showed that silicones with a higher Rp and Rv had bigger particles than the rest of samples



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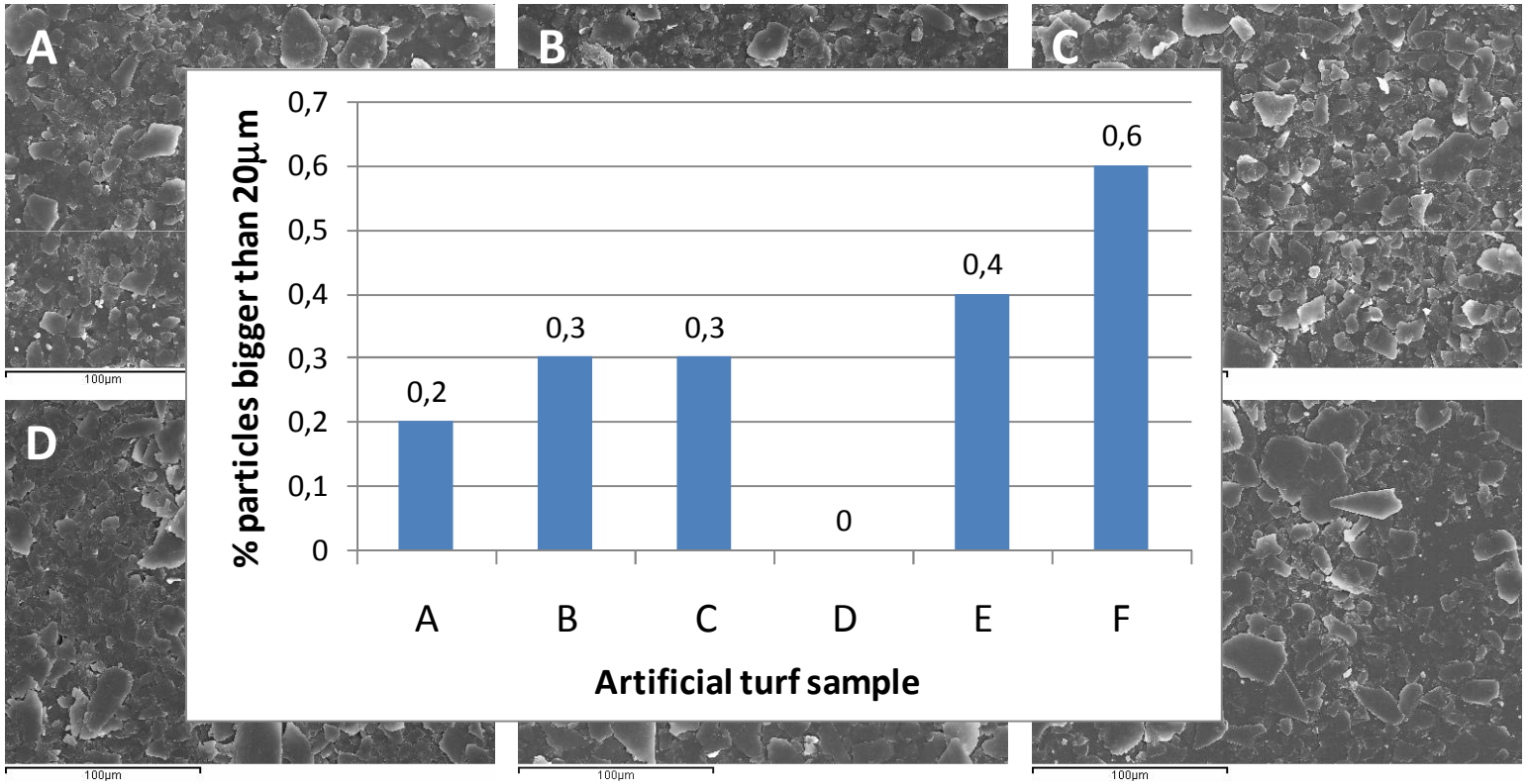
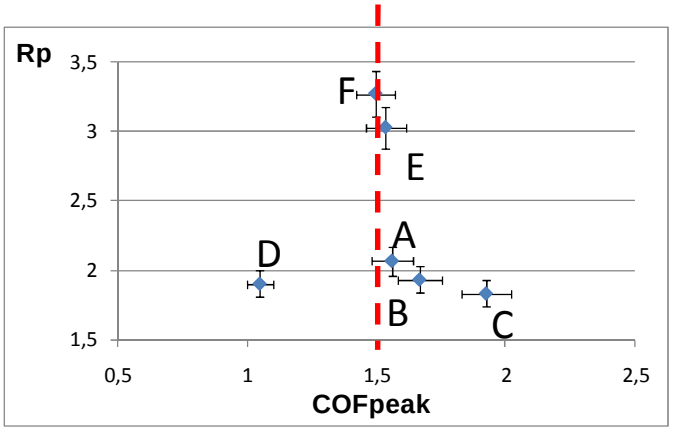
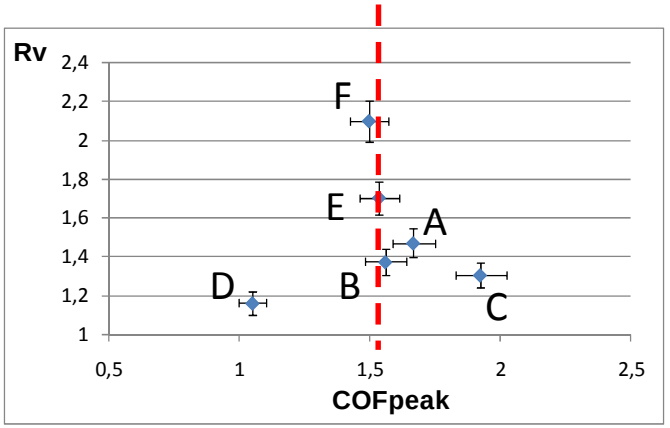
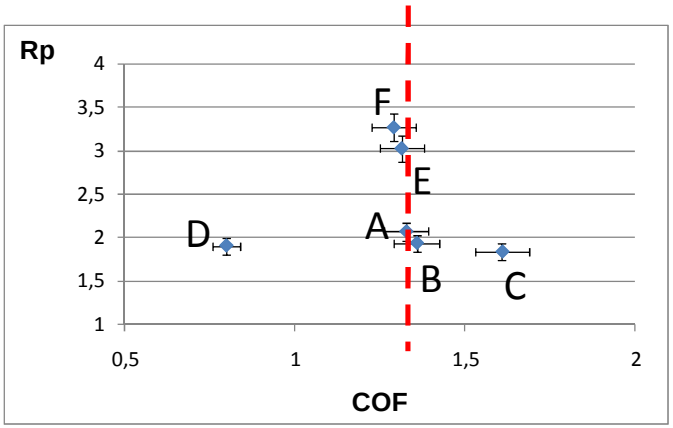


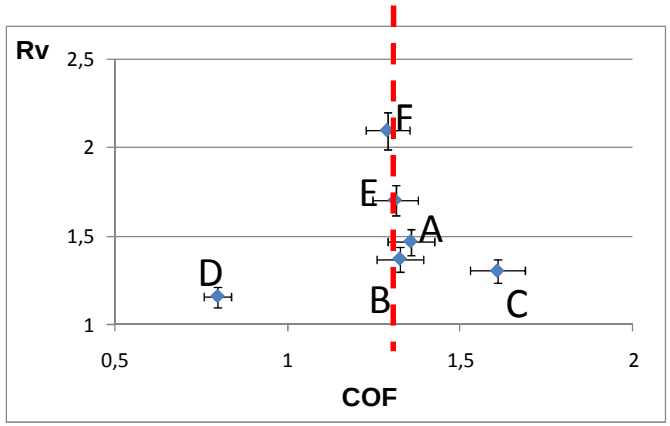
Results

- There is no relation between COF or COFpeak and roughness



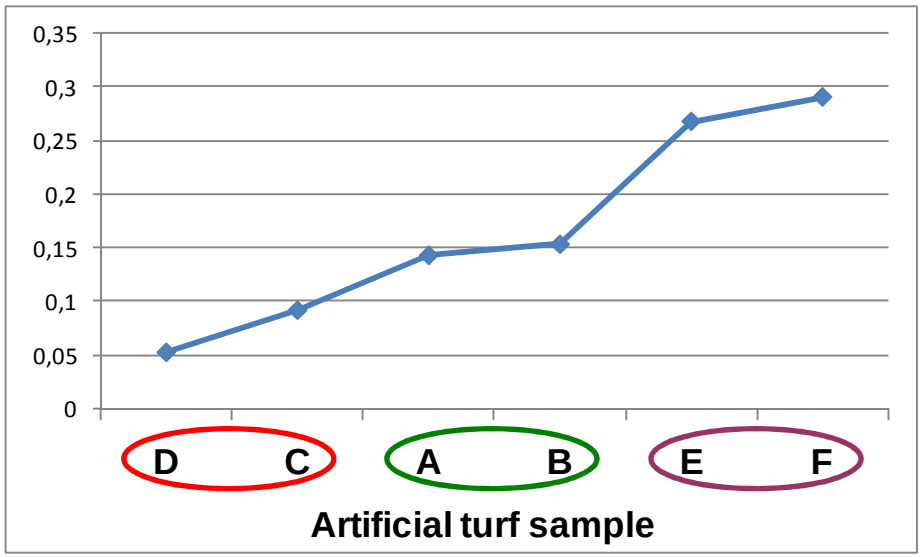


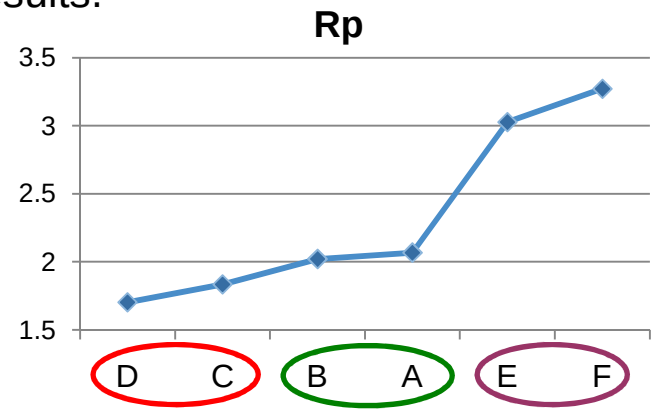


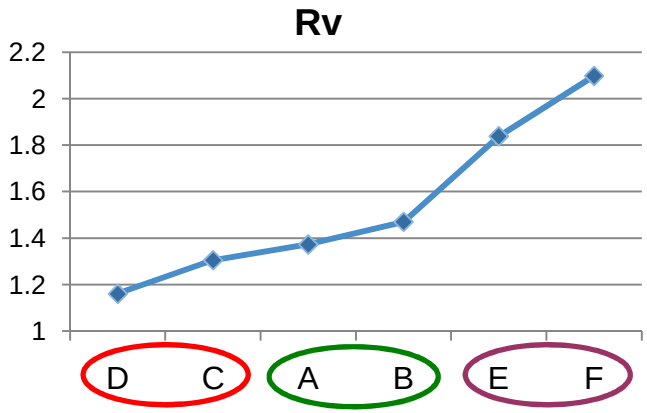


Results

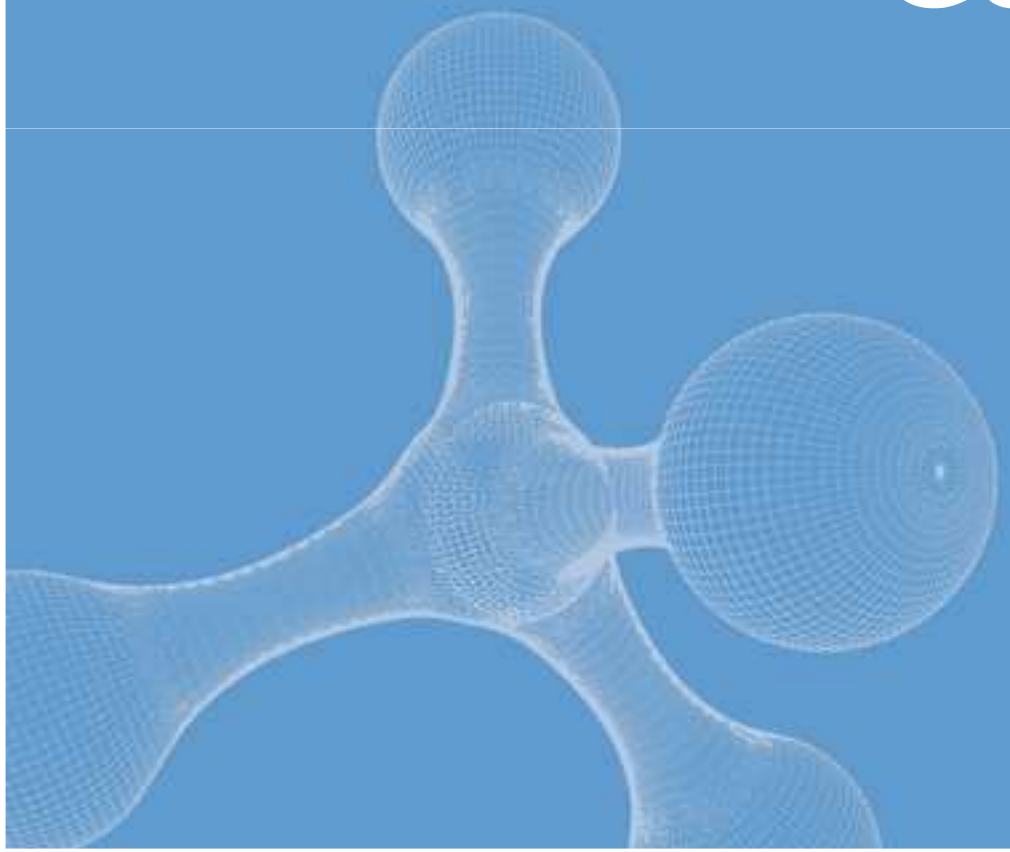
• The order of samples from lesser to larger abrasiveness in the subjective study exhibits an excellent agreement with the roughness analysis results. There is a good correlation between human perception and the study of roughness results.







Conclusions



Conclusions

• The evaluation of abrasion in skin is a very difficult task since a silicone is being used as a substitute of the skin

• The correlation between the coefficient of friction (static or dynamic) and the damage in silicone (roughness values) is not a good; it seems plausible that another mechanism of damage occurs

• However, there is a good correlation between human perception and the damage in the silicone after the mechanical test (study of roughness)

• The use of image analysis (SEM) allows the observation of bigger particles in silicones with higher values of roughness. Therefore image analysis shows a good correlation with human perception: the samples evaluated as more abrasive have produced a higher damage in silicone.

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