An Analysis of Surface Profile for Cylindrical Osteochondral Grafts of the Knee

INTRODUCTION:
Focal chondral and osteochondral defects of loading surfaces often cause problems for patients including pain, swelling, clicking, and instability, and may lead to early degenerative changes. Autogenous osteochondral grafting has been widely performed as a solution for creating hyaline or hyaline-like cartilage repair in the pathological area. In this procedure, it is ideal to match the shape of the articular surface between the recipient and the donor site to reproduce the original articular surface of the femoral condyle. However, surgeons may sometimes encounter the mismatching of the articular surface between the recipient and the donor. Thus, surgeons should select the donor site based on the size and shape of the recipient site.

The purpose of this study was to investigate the matching of the articular surface between the recipient and the donor site using 3D laser scanning method and clarify the matching pattern leading to the ideal transplantation of the recipient site.

METHODS:
Six cadaveric knees (Left: three, Right: three) were employed for this study. The skin and soft tissues around the knee joint were removed with each specimen and the femoral side of the femur was osteotomized at the mid-femur level. After the preparation, the specimens were fixed with the specially made polyvinyl chloride tube for the data acquisition. The 3D laser scanner (FastSCAN®; Polhemus.) was used to obtain 3D profile of the knee. This device consists of a receiver with laser scanner, a transmitter and a signal processing unit (Fig. 1-A). The transmitter was placed near a cadaveric specimen by using a tripod (Fig. 1-B).

The analysis method aims to calculate the height difference of the cylindrical graft surface. In this surgery, the graft is harvested by harvesters as a 6 mm, 8 mm, and 10 mm cylindrical shape. Because the surface of the axis direction is convex due to the hemisphere of the femoral condyle, the vertical interval of the convex was considered as target information. The analysis method consists of next four steps. The first step is to indicate a point of the joint surface from the obtained data (Fig. 2 (a)). The second step is to calculate of normal vector of the indicated point (Fig. 2 (b)). The third step is to determine an analysis area of a constant diameter from the normal vector (Fig. 2 (c)). The fourth step is to calculate the vertical interval from the highest and lowest points along the normal vector within the analysis area (Fig. 2 (d)).

RESULTS:
6mm graft: In the top area of the donor site, there were no statistical difference in both the edge and top area of the recipient site. The edge area of the donor site was statistically higher than the top area of the recipient site. (Fig. 4-A)
8mm graft: In the top area of the donor site, there were no statistical difference in both the edge and top area of the recipient site. The edge area of the donor site was statistically higher than the top area of the recipient site. (Fig. 4-B)
10mm graft: The top area of the donor site was statistically lower than the edge area of the recipient site. The edge area of the donor site was statistically higher than the top area of the recipient site. (Fig. 4-C)

DISCUSSION:
We demonstrated the matching of the articular surface shape between the donor site and the recipient site in autogenous osteochondral grafting. This study indicated that the osteochondral graft harvested from the edge area might protrude for the top area in recipient site and the 10mm osteochondral graft harvested from the top area might be depressed for the edge area in recipient site. Therefore, surgeons should take the diameter and location of the graft into consideration so as to acquire the ideal and smooth surface of recipient site.

REFERENCES: