Horizon Scanning Brief Report

Implantation of Polyurethane Scaffold for the Treatment of Partial Meniscal Lesions

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NECA National Evidence-based Healthcare Collaborating Agency
H-SIGHT Horizon Scanning Service for Innovative Global Health Technology

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BASIC INFORMATION	
Identification No.	H-SIGHT-2014-132
Report No.	H-SIGHT-2014-001
Technology type	Medical device, medical practice
Name of technology	Implantation of Polyurethane Scaffold for the Treatment of Partial Meniscal Lesions
Product and Developer	ACTIFIT®, Orteq Ltd. / U.K.
Target group	Patients with meniscal tears or partial meniscus loss
Purpose	To facilitate the natural meniscal tissue regeneration and repair meniscus by inserting a biodegradable synthetic material into an area of meniscal lesions
Innovativeness	The alternative technology, meniscal allograft transplantation, has satisfactory mid-term and long-term clinical results. However, there are some disadvantages of using an allograft, such as availability and the risk of disease transmission. Additionally, it is invasive and not suitable for small meniscal lesions. The polyurethane scaffolds are easy to obtain and store, and the implantation preserves as much meniscal tissue as possible. Thus, the technology could provide an effective treatment for partial meniscal lesions and fulfil the clinical needs.
Estimated time point of market entry in South Korea	Three years and up
Stage of development	Established
Utilization(Licensing, reimbursement, and other approval)	The technology has been adopted in European countries since it was granted the CE mark in 2008, but it has not been approved from the U.S. Food and Drug Administration yet. In South Korea, polyurethane scaffold has obtained an importing license from the Ministry of Food and Drug Safety (MFDS) in 2013 (No.13-1285) with the specific indication of treatment of meniscal lesions.
Technology setting	Specialty hospitals (Orthopedics)

SUMMARY

- The biodegradable polyurethane scaffold was developed for the purpose of treating meniscal defects
- Currently, the only form of treatment by transplantation available in South Korea is the meniscal allograft transplantation, which involves replacement by a cartilage from a human donor
- The implantation of a polyurethane scaffold removes the damaged area and transplants a synthetic material to promote vessel ingrowth and natural regeneration of the meniscal tissue

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BACKGROUND AND BURDEN OF DISEASE

Meniscal lesions are one of the most frequently occurring knee injuries. The meniscus can be damaged during a sports activity or traffic accident, or due to cartilage degeneration with aging. Failure to treat meniscal lesions can lead to damage of the articular cartilage, arthritis, and loss of knee joint function[1)2)].

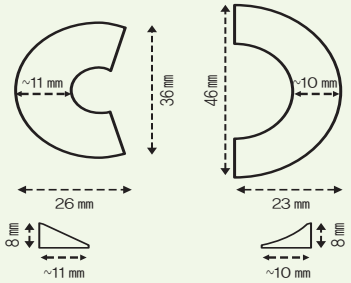
Meniscal lesions have an incidence of 60 to 70 in every 100,000 individuals[2)]. In South Korea, the frequency of meniscal transplantation performed to treat meniscal lesions has increased annually from 369 in 2010 to 390 in 2011 and to 516 in 2012[3)]. Medical expenses for meniscal transplantations in 2012 totaled 280 million KRW, representing a 41% increase from 2010[3)].

DESCRIPTION OF THE HEALTH TECHNOLOGY

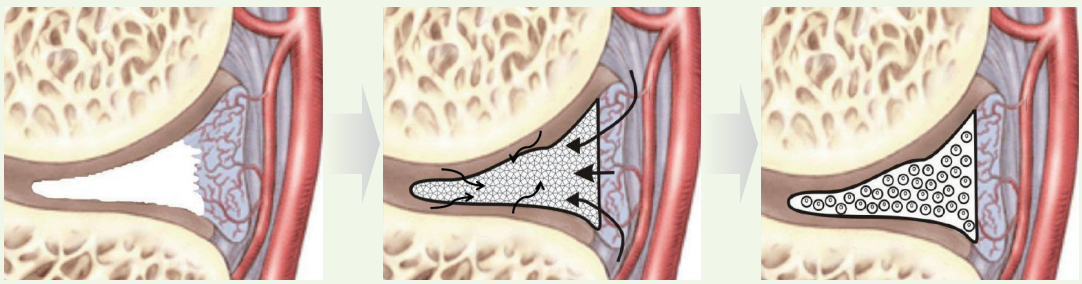
Implantation of polyurethane scaffold for the treatment of partial meniscal lesions involves removing the ruptured or damaged area and implanting a three-dimensional absorptive synthetic material to promote natural regeneration of the meniscus[4)].

During the procedure, polyurethane scaffold, shown in Figs. 1-2, is attached to the vascularized zone of the meniscus. Cellular infiltration and vascular ingrowth occur over time to facilitate tissue regeneration of the surrounding cells. Ultimately, the regenerated functional tissue starts to fulfill the role of the native meniscus (Fig. 3).

〈Fig. 1〉 Polyurethane scaffold[5)]



〈Fig. 2〉 Scaffold model for lateral and medial implant[6)]



〈Fig. 3〉 Principles of operation: an attached polyurethane scaffold to the vascularized zone of the menisus (left) facilitates tissue regeneration of surrounding cells through cellular infiltration and vascular ingrowth (center), and the regenerated tissue starts to fulfill the role of the native meniscus (right)[7)].

Implantation procedure

The procedure is as follows:

① Debriding the damaged section of the meniscus
② Inserting a meniscal ruler into the affected area using an arthroscope and measuring the size of the damaged meniscus
③ Determining and cutting the appropriate size of polyurethane scaffold to be inserted
④ Inserting the scaffold into the affected area and suturing it in place

※ **Exclusion criteria** ① insufficient posterior cruciate ligament; ② International Cartilage Repair Society classification ≥3; ③ deformity or malalignment syndrome; ④ history of allergic reaction to polyurethane; ⑤ systemic or local infection; ⑥ treatment with corticosteroid, antitumor agent, or immunosuppressant 30 days before polyurethane scaffold implantation; ⑦ osteonecrosis of the knee; ⑧ history of rheumatoid arthritis, recurrent polychondritis, severe degenerative osteoarthropathy, inflammatory arthritis, or other related disease; ⑨ overweight or obese (body mass index >35㎏/㎡); or ⑩ neurologic symptoms preventing adherence to the rehabilitation program

ALTERNATIVE, COMPLEMENTARY AND/OR CURRENT TECHNOLOGY

Current treatment options available in Korea are arthroscopic meniscal repair, meniscectomy, and allograft transplantation. It has been reported that meniscectomy poses a risk of complications such as increased pressure on the contact surface of the joint and damage of the articular cartilage after surgery.

As an alternative measure, meniscal allograft transplantation is performed to restore meniscal function[8]. However, meniscal allograft transplantation is not suitable for partial resection, and it poses concerns related to availability, very long waiting time for a suitable transplant, the possibility of disease transmission, and nerve damage. Thus, there has been an increased demand for synthetic meniscal scaffold made of a new type of biomaterial[9][10]. The U.S.-based ReGen Biologics developed collagen scaffold (product name: Menaflex), which received Food and Drug Administration (FDA) approval (510[K] clearance) in 2008 and became widely used for meniscal implantation. However, the FDA rescinded the product's marketing clearance in 2010 due to the lack of evidence for efficacy after post market evaluation of the device[11].

In South Korea, meniscal allograft transplantation is conditionally acknowledged for health care coverage[12].

EVIDENCE

Safety

Of the seven studies that assessed the safety of the new technology, four (Kon *et al.*, Bouyarmane *et al.*, Efe *et al.*, and Bulgheroni *et al.*) reported no major post-operative complications or adverse effects. Spencer et al. observed variable amounts of regenerative tissue through second-look arthroscopy at a mean of 12.8 months[13][14][15][16][17]. On the other hand, Verdonk P. *et al.* and Verdonk R.*et al.* reported adverse events and serious adverse events as well as loss to follow-up and treatment failures[18][19].

Effectiveness

Of the seven studies that assessed the effectiveness of the health technology in question, six reported significant improvement in function and pain relief[13][14][15][17][18][20]. Bulgheroni *et al.* observed improved mean scores of clinical outcomes (visual analog scale, Lysholm, Tegner) at six months, but did not report their statistical significance[16].

In a review of previous studies and existing health technologies for the treatment of meniscal tears, Scotti et al. reported that in comparison with collagen scaffold, polyurethane scaffold had superior mechanical strength and was easier to handle, and that

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degradation occurred more slowly (four to six years on average)[20]. Although short-term follow-up observations revealed that implantation using polyurethane scaffold resulted in good clinical outcome, there was insufficient evidence obtained on long-term studies. Thus, more long-term evidence on the safety and effectiveness should be accumulated for this technology to be considered as valid for partial meniscal implantation.

International Health Technology Assessment Report

In 2012, based on a systematic literature review, the National Institute for Health and Care Excellence in the U.K. presented an interventional procedure guidance containing safety and effectiveness of the partial replacement of the meniscus using biodegradable scaffold[21]. Of the eight papers included in the review, two were on polyurethane scaffold (Spencer et al. and Verdonk P. et al.)[17][18]. The guidance included three specialist advisors' opinions on partial replacement of the meniscus using biodegradable scaffold, and they all agreed that the procedure is novel, but its safety and effectiveness are uncertain.

COST INFORMATION

Total cost per procedure in Europe: approximately £4,000[22]
- Medical device: polyurethane scaffold, approximately £2,000
- Medical practice: costs related to the procedure, approximately £2,000

ONGOING RESEARCH

Clinicaltrials.gov and Cochrane Library were searched for research protocols as well as clinical trials and systematic reviews that are currently being conducted, but none were found.

SOCIAL IMPACT (EXPERT OPINION)

The opinions of four experts in the medical field concerned, selected at random from a pool of 826 health technology assessment specialists at the National Evidence-based Healthcare Collaborating Agency, are given as follows:

Meniscal allograft transplantation, an alternative technology, has a drawback in that, it cannot be performed when the cartilage obtained does not meet the criteria. On the other hand, polyurethane scaffold has the potential to satisfy the diverse needs of patients and meet the high demand of surgeries. However, the high-cost polyurethane scaffold may make it available to only a certain group of the public, making care inaccessible to some. Further, there is insufficient evidence supporting the logic behind the indications and mechanisms of the technology. Moreover, the majority of related-studies were based on short-term follow-up observations lasting less than two years, without any validation process involving a long-term comparison between the intervention and control groups. In order to prevent indiscriminate use of the technology and ensure its safe application after its introduction into the medical market, additional evidence is required to clearly support its safety and effectiveness.

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This report was compiled to provide objective information on an emerging health technology that is currently under development. Reference to the materials reviewed was made at the Committee meeting held to deliberate on Implantation of Polyurethane Scaffold for the Treatment of Partial Meniscal Lesions, for which a New Health Technology Assessment was requested in 2013. Further information was derived through a literature review and consultation with medical specialists in the relevant field. Further, please note that the National Evidence-based Healthcare Collaborating Agency and the researchers who compiled this report have no conflicts of interest with any of the enterprises that specialize in the medical field in question.

[ATTACHMENT] Summary of Preceding Studies

As of May 2014, there were eight studies on implantation of polyurethane scaffold for the treatment of partial meniscal lesions, of which one was a prospective cohort study and seven were case series.

#	Year	Author	Study design	Study population	No. of patients	Treatment	Follow-up periods (mo)	Conflicts of interest
1	2012	Spencer et al.[17]	Prospec-tive cohort	Patients with painful knee following partial meniscectomy	23	Partial replacement of meniscus with collagen(n=12) or polyurethane (n=11) scaffold: lateral-9, medial-14	6, 12, 18, 24	Not reported
2	2014	Kon et al.[13]	Case series	Patients with irreparable acute meniscal tears requiring partial meniscectomy or chronic prior loss of meniscal tissue	18	Arthroscopic poyurethane scaffold implantation: lateral-5, medial-13	6, 12, 24	Not reported
3	2014	Bouyarmane et al.[14]	Case series/ multi-center	Patients with postmeniscecto-my syndrome and segmental lateral meniscus loss	54	Arthroscopic polyurethane scaffold implantation	6, 12, 24	None
4	2013	Coninck et al.[20]	Case series	Patients with irreparable symptomatic meniscal tear or partial meniscus loss with intact peripheral rim and anterior and posterior horns	26	Polyurethane scaffold implantation: lateral-8, medial-18	3, 12, 24	Not reported
5	2013	Bulgheroni et al.[16]	Case series	Patients with irreparable meniscal tears requiring excision of more than 25% of meniscal tissue or pain after previous partial meniscectomy	19	Polyurethane scaffold implantation: lateral-16, medial-2, bilateral-1	6, 12, 24	Not reported
6	2012	Efe et al.[15]	Case series	Patients with segmental tissue loss from medial meniscus	10	Polyurethane scaffold implantation: medial-10	6, 12	None
7	2012	Verdonk P. et al.[18]	Case series/ multi-center	Patients with irreparable partial meniscal defects	52	Polyurethane scaffold implantation: lateral-18, medial-34	6, 12, 24	- One author is an employee of Orteq Ltd andowns stock - All other authors or their departments received funding/sponsorship from Orteq - Two received compensation as scientific advisors to Orteq - Five received symposium reimbursement or fees for speaking - Orteq helped prepare the first draft of the study
8	2011	Verdonk R. et al.[19]	Case series/ multi-center	Patients with irreparable medial or lateral meniscal tear or partial meniscus loss with intact rim	52	Polyurethane scaffold implantation: lateral-18, medial-34	3, 12	- One author is an employee of Orteq Ltd. - All other authors or their departments received funding/sponsorship from Orteq Ltd.

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