MERIT RESEARCH JOURNALS
www.meritresearchjournals.org

Merit Research Journal of Medicine and Medical Sciences (ISSN: 2354-323X) Vol. 7(3) pp. 094-099, March, 2019
Available online http://www.meritresearchjournals.org/mms/index.htm

DOI: 10.5281/zenodo.2604710

Original Research Article

Metatarsal Head Resurfacing versus Total Joint Arthroplasty in the Treatment of Hallux Rigidus

Safa Gursoy* and Mustafa Akkaya

Ankara Yildirim Beyazit University, Department of Orthopedics and Traumatology, 06800 Ankara, Turkey

***Corresponding Author's Email: safagursoy@yahoo.com**
Tel: +90 312 5872000 / 2292
Fax: +90 312 5872526

Abstract

Currently, there are many alternatives for the treatment of hallux rigidus, which is arthrosis of the first metatarsophalangeal joint. Our aim in this study is to compare the effectiveness of metatarsal head resurfacing and total joint arthroplasty in the treatment of hallux rigidus. We retrospectively compared the patients in Group 1 (n:21) who underwent resurfacing and the patients in Group 2 (n:23) who underwent total joint arthroplasty. The mean length of follow-up and mean age of the patients included in the study was 41.2±3.7 and 54.3±7.8, respectively. American Orthopedic Foot and Ankle Society's (AOFAS) hallux metatarsophalangeal-interphalangeal, and visual analog scale (VAS) scores were used to compare the functional status of the patients. There was no statistically significant difference between the demographic characteristics of the patients in both groups (p>0.05). Comparison of the functional scores obtained during patient follow-up revealed that AOFAS functional results of the patients in Group 2 were statistically significantly better at postoperative months 24 and 36 (p<0.05). There was no statistically significant difference between the two groups in terms of the change in VAS scores with respect to time (p>0.05). The use of resurfacing and total joint arthroplasty, which enable joint motion, in the treatment of hallux rigidus leads to successful outcomes in the mid-term.

Keywords: Hallux rigidus, Metatarsal head resurfacing, Total joint arthroplasty, Functional outcomes

INTRODUCTION

Hallux Rigidus (HR) is a common degenerative foot condition characterized by the symptoms of pain and decreased range of motion of the first metatarsophalangeal joint (MTPJ) (Brage and Ball, 2002). Hallux rigidus was first described by Davies-Colley in 1887(Davies-Colley 1887). Although the pathogenesis of HR has not been clearly defined, trauma, recurrent microtrauma, long first metatarsal bone and unsuitable shoe selection are among the factors that cause the condition.The treatment method for hallux rigidus depends on the gender, age and physical condition of the patient. There are many treatment options according to the literature. Corrective osteotomy or cheilectomy of the MPJ are effective in the treatment of early to mid-stage hallux rigidus. On the other hand, arthrodesis or arthroplasty of the MTPJ are frequently preferred in the treatment of advanced HR (Maffulli, Papalia et al., 2011).

Conservative methods such as shoe modification, oral anti-inflammatory drug use and intraarticular injections can be effective in the treatment of early stage HR. Plantar fascia release, cheilectomy and decompression osteotomy can be effective when conservative treatments fail to succeed (Grady, Axe et al. 2002). On the other hand, the treatment method for advanced HR is

controversial. Resection-interposition arthroplasty, proximal phalanx or metatarsal head resurfacing hemiarthroplasty, total joint replacement (TJR) and arthrodesis have been used for treating these patients (Mulier, Steenwerckx et al. 1999, Ess, Hamalainen et al. 2002, Miller 2004, Kennedy, Chow et al. 2006).The question that which one among arthroplasty and arthrodesis will best suit the patient's requirements, activities and pain level is still controversial. Arthrodesis was reported to be the reference standard treatment since it was published in the literature and has proven reliability for a long time. On the other hand, it has several risks such as transfer metatarsalgia, limitations in shoe selection, delayed union and nonunion (Brage and Ball, 2002, Giannini, Ceccarelli et al., 2004).

Orthopedic surgeons have used MTPJ arthroplasty for the last 60 years. Various arthroplasty implants have been used in order to restore the functions of the first MTPJ(Swanson, Lumsden et al. 1979, Koenig and Horwitz 1996, Konkel, Menger et al. 2008, Cook, Cook et al. 2009, Konkel, Menger et al. 2009).Despite the poor mid- and long-term outcomes with the earliest implants, improved implant performance and durability was observed within the coming years due to the advances in design and metallurgy. Use of implants is now a successful and suitable procedure in the treatment of HR.

Today, implants that are commonly used in the treatment of the first MTPJ arthrosis can be applied on one surface of a joint such as resurfacing or on both surfaces a joint such as total joint arthroplasty.In this study, we aim to compare the mid-term functional outcomes of metatarsal head resurfacing and total arthroplasty of the first MTPJ in the treatment of advanced hallux rigidus.

PATIENTS AND METHOD

We retrospectively screened 51 patients who were operated for hallux rigidus at our clinic between 2014 and 2016. Patients with a hallux valgus angle higher than 10 degrees, intermetatarsal angle higher than 8 degrees as well as patients with infection in the joint, osteomyelitis findings and patients diagnosed with inflammatory disease were excluded from the study. Patients who had grade 2 and 3 hallux rigidus before the surgery according to the Hattrup and Johnson Classification System, who completed the 3-year follow-up period and did not possess the traits in the exclusion criteria were included in the study. Patients who fulfilled the inclusion criteria and underwent metatarsal head resurfacing constituted Group 1 and patients who underwent total MTPJ arthroplasty constituted Group 2.The surgical intervention was explained in detail to all patients and the patients signed an informed consent form for the operative technique that will be performed. For all patients included in the study, surgical procedures were performed by two surgeons.

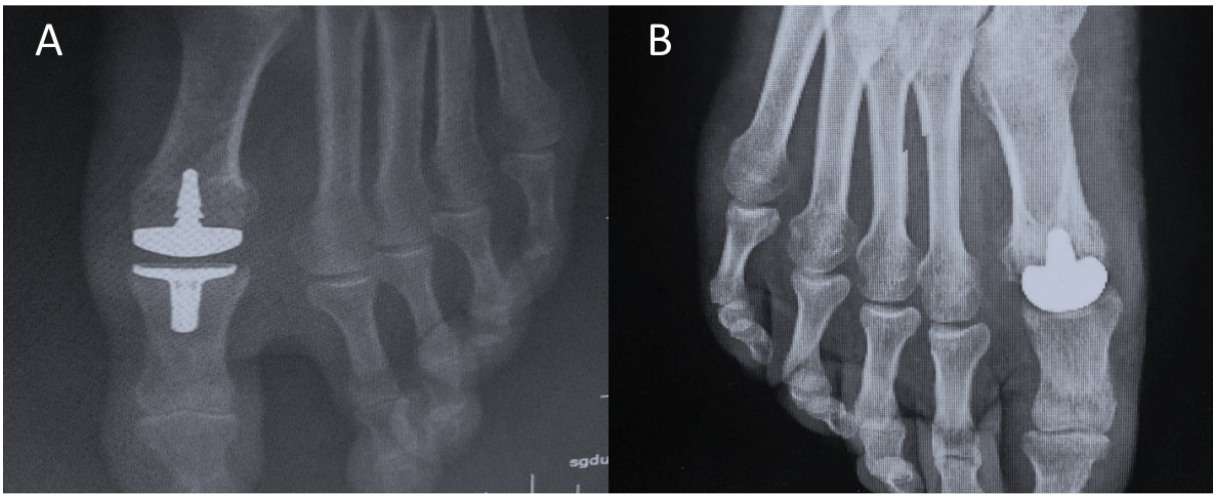
Preoperative and postoperative functional status of the patients in both groups were evaluated and compared according to the American Orthopedic Foot and Ankle Society's (AOFAS) hallux metatarsophalangeal-interphalangeal scale and visual analog scale (VAS) scores.

Surgical Technique

All surgical procedures were performed under regional anesthesia after applying a tourniquet on the lower limb and administering prophylactic antibiotic (first generation cephalosporin 2 mg/kg) therapy. The joint was accessed from the capsule by making a dorsal incision over the first MTPJ and retracting the extensor tendon towards the lateral aspect. A longitudinal incision was made through the joint capsule and the capsule was released proximally over the metatarsal bone and distally over the proximal phalanx. Joint mouse and osteophytes were cleaned, and the joint was brought to a suitable flexion angle in order to continue the surgical procedure. Then, a guide wire was sent to the metatarsal head in accordance with the alignment. After reamerisation and washing steps according to the surgical technique, a metatarsal head resurfacing implant was placed in patients in Group 1 according to the measured size. An intramedullary guide wire was placed in the phalanx in accordance with the alignment for the implant that will be placed on the proximal phalangeal joint surface in patients in Group 2. Following suitable reamerisation, phalangeal component was combined with a polyethylene insert and implanted in the phalanx. Joint capsules as well as skin and subcutaneous layers were closed after the implantation in all patients in both groups. Sample x-rays of the both groups were given in Figure 1. After the surgery, controlled weight bearing was ensured with the use of post-op shoes. Joint range of motion was not restricted.

Statistical Analysis

Statistical analysis was performed using the statistical package SPSS software (Version 24.0, SPSS Inc., Chicago, IL, USA). If continuous variables were normal, they were described as the mean ± standard deviation ($P>0.05$ in Shapira-Wilk ($n<30$)), and if the continuous variables were not normal, they were described as the median. Comparisons between groups were applied using Student T-test for normally distributed data. The categorical variables between the groups were analyzed using the Chi square test. Values of $P< 0.05$ were considered statistically significant.



Anteroposteriorxray of a Total JointArthroplasty(A), anteroposteriorxray of a metatarsalheadresurfacing(B).

Figure 1. Postoperative X-rays.

Table 1. Baseline Characteristics

	Group 1 (Resurfacing) (n=21)		Group 2 (TJA) (n=23)		Total		
	n	**%**	**N**	**%**	**n**	**%**	***P value***
Gender							
Female	14	66.7	16	69.5	30	68.2	0.837
Male	7	33.3	7	30.5	14	31.8	
Side							
Right	11	52.4	12	52.2	23	52.3	0.989
Left	10	47.6	11	47.8	21	47.7	

	Mean±SD	**Mean±SD**	**Mean±SD**	***P value***
Age(years)	52.4±6.8	56.2±8.8	54.3±7.8	0.119
BMI (kg/m^2)	30.3±4.1	28.9±3.7	29.6±3.9	0.241
Follow-up (month)	40.1±3.1	42.2±4.2	41.2±3.7	0.068

n: Number of patients, TJA: Total Joint Arthroplasty, BMI: Body mass index, SD: Standard deviation

Table 2. AOFAS-HMI andVAS scoresbetweengroupsduringfollow-upperiods.

Followup	**Group 1 (Resurfacing) (n=21)**	**Group 2 (TJA) (n=23)**	
	Mean±SD	**Mean±SD**	***Pvalue***
AOFAS-HMIscore			
Preop	38.63±8.32	36.91±6.54	0.448
12 months	88.23±3.86	90.23±4.12	0.105
24 months	83.34±4.65	86.56±3.56	**0.013**
36 months	81.54±3.87	85.96±4.78	**0.0017**
VAS score			
Preop	8.89±2.01	9.01±1.87	0.838
12 months	2.23±0.78	2.35±0.23	0.484
24 months	1.65±0.28	1.80±0.34	0.120
36 months	2.01±0.56	1.96±0.23	0.696

n: Number of patients, SD: Standard deviation, TJA: Total Joint Arthroplasty, AOFAS-HMI: American Orthopedic Foot and Ankle Society's Hallux Metatarsophalangeal-Interphalangeal, VAS: Visual Analog Scale

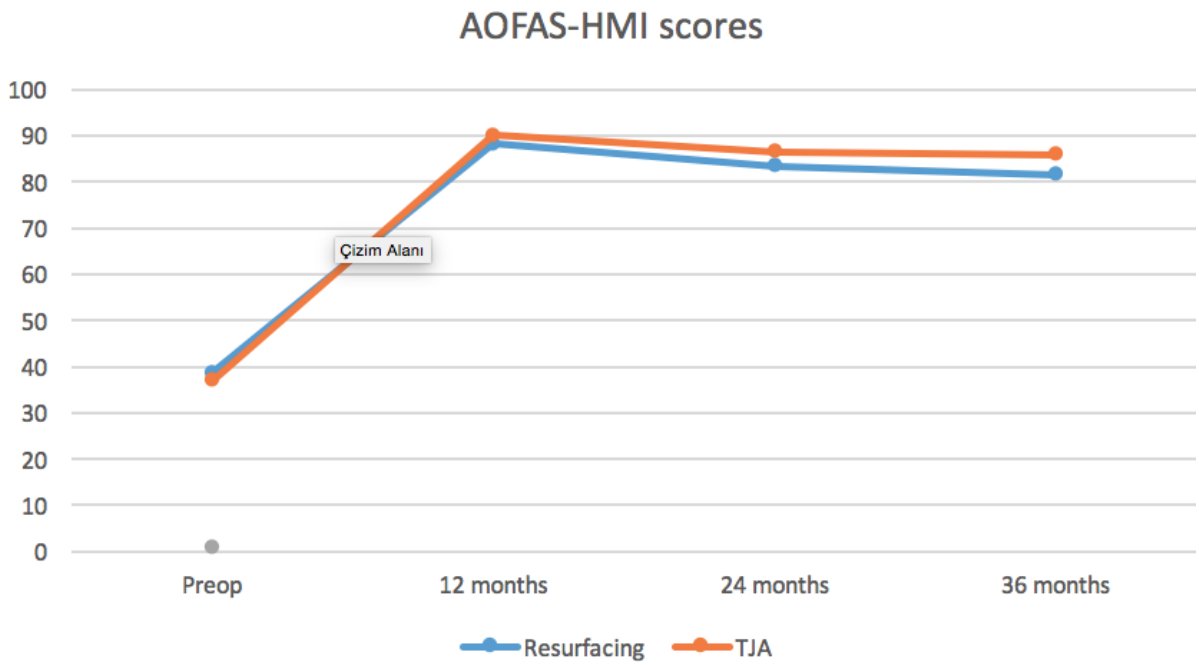


Figure 2. AOFAS-HMIscoresduringfollow-upperiods. (AOFAS-HMI: American Orthopedic Foot and Ankle Society's Hallux Metatarsophalangeal-Interphalangeal)

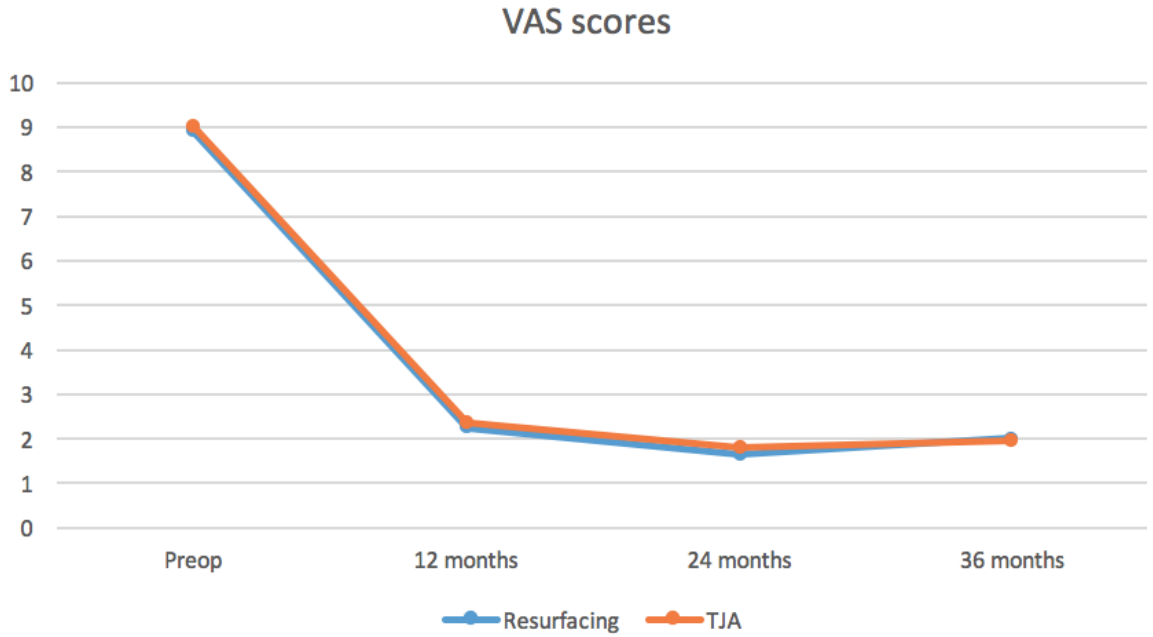


Figure 3. VAS scoresduringfollow-upperiods. (VAS: Visual Analog Scale)

RESULTS

7 patients who did not meet the inclusion criteria, who possessed the exclusion criteria or were lost to follow-up were excluded from the study. The mean length of follow-up was retrospectively determined to be 41.2±3.7 for 21 patients in Group 1 who underwent metatarsal head resurfacing and 23 patients in Group 2 who underwent total joint arthroplasty. Mean age of the patients in group 1 and group 2 was 52.4±6.8 and 56.2±8.8, respectively. Female/male ratio was 14/7 and 16/7 in Group 1 and Group 2, respectively. Distribution of the patients' demographic characteristics by groups is provided in detail in Table 1. There was no statistically significant difference between the demographic characteristics of the patients in both groups ($p>0.05$). Comparison of the

functional scores obtained during patient follow-up revealed that only AOFAS functional results of the patients in Group 2 were statistically significantly better at postoperative month 24 ($p<0.05$). There was no statistically significant difference between the two groups in terms of the change in VAS scores with respect to time ($p>0.05$). Distribution of the functional scores of the patients in both groups throughout the follow-up period is provided in Table 2 and Figures 2 and 3.

DISCUSSION

In this study, we compared two common treatment options for advanced hallux rigidus cases, i.e. metatarsal head resurfacing and total MTPJ arthroplasty. Although there was no statistically significant difference in VAS scores between the two groups, it was shown that AOFAS hallux metatarsophalangeal-interphalangeal scores were better in the total joint arthroplasty group. Hallux rigidus is a very prevalent disorder that significantly reduces the quality of life of patients and limits their participation to daily activities (Hamilton, O'Malley et al. 1997).

Many treatment alternatives have been defined for the treatment of this disorder until today, wherein mid- and long-term effectiveness of these alternatives has been shown individually. Arthrodesis, resection arthroplasty, resurfacing and total joint arthroplasty are some of these alternatives. Arthrodesis is considered to be one of the most reliable treatments for pain relief in advanced hallux rigidus cases (DeFrino, Brodsky et al., 2002). Arthrodesis can also be applied as a rescue procedure when other treatment options fail to succeed. Studies have shown that the success rate of arthrosis is higher than 90% with suitable fixation techniques (Coughlin 1990; Coughlin and Abdo, 1994). As seen in every treatment option, arthrodesis was also reported to have several unwanted outcomes and complications such as malunion, nonunion and limitation of daily activities (Brage and Ball, 2002, Giannini, Ceccarelli et al., 2004). Moreover, many patients do not accept to have an immobile great toe joint and they request a moving joint without pain (Berlet, Hyer et al., 2008).

There are studies that aim to show the effectiveness of total joint arthroplasty, which is an important treatment option for advanced hallux rigidus cases who expect to have a moving joint. Two studies with follow-up periods longer than 3 years have shown that the improvement in functional results and patient satisfaction were between 77 and 91% following total joint arthroplasty (Pulavarti, McVie et al., 2005, McGraw, Jameson et al., 2010).

In a study by Carpenter et al., it was reported that revision was not observed and AOFAS scores were successful throughout the follow-up period of more than two years after application of metatarsal head resurfacing technique, which involves unilateral joint resurfacing (Carpenter, Smith et al., 2010).

In a similar study, it was demonstrated that the rate of revision was 2% and patient satisfaction was high among 100 patients who underwent resurfacing (Hasselman, 2008).There are many studies comparing arthrodesis and arthroplasty in the literature. Park et al. compared 7 comparative studies in an up-to-date meta-analysis and showed that there was no statistically significant difference between the two groups in terms of American Orthopedic Foot and Ankle Society-Hallux Metatarsophalangeal Interphalangeal score, patient satisfaction rate, reoperation rate or complication rate (Park, Jung et al., 2019).

Erdil et al. compared three different techniques, i.e. arthrodesis, resurfacing and total joint arthroplasty, and showed that all groups exhibited functional improvement after 2-year follow-up (Erdil, Elmadag et al., 2013).

An important limitation of our study was that it was not a prospective, randomized study and included retrospective data. Short follow-up period is another limitation, as we could not observe the potential long-term complications. Moreover, the fact that we did not use scoring systems that indicate patient satisfaction, which is frequently reported in the literature, is among the weaknesses of our study. On the other hand, one of the strengths of our study is that it can contribute to the literature since it included a uniform patient population and it was a comparative study.

CONCLUSION

In conclusion, the use of resurfacing and total joint arthroplasty,which enable joint motion, in the treatment of advanced hallux rigidus cases leads to successful outcomes in the mid-term.

REFERENCES

Berlet GC, CF Hyer, TH Lee, TM Philbin, JF Hartman, ML Wright (2008). "Interpositional arthroplasty of the first MTP joint using a regenerative tissue matrix for the treatment of advanced hallux rigidus." Foot Ankle Int29(1): 10-21.

Brage ME, ST Ball (2002). "Surgical options for salvage of end-stage hallux rigidus." Foot Ankle Clin7(1): 49-73.

Carpenter B, J. Smith, T. Motley, A. Garrett (2010). "Surgical treatment of hallux rigidus using a metatarsal head resurfacing implant: mid-term follow-up." J Foot Ankle Surg49(4): 321-325.

Cook E, J. Cook, B. Rosenblum, A. Landsman, J. Giurini, P. Basile (2009). "Meta-analysis of first metatarsophalangeal joint implant arthroplasty." J Foot Ankle Surg48(2): 180-190.

Coughlin MJ (1990). "Arthrodesis of the first metatarsophalangeal joint with mini-fragment plate fixation." Orthopedics13(9): 1037-1044.

Coughlin MJ, RV Abdo (1994). "Arthrodesis of the first metatarsophalangeal joint with Vitallium plate fixation." Foot Ankle Int15(1): 18-28.

Davies-Colley M (1887). "Contraction of the metatarsophalangeal joint of the great toe." BMC1: 728.

DeFrino PF, JW Brodsky, FE Pollo, SJ Crenshaw, AD Beischer (2002). "First metatarsophalangeal arthrodesis: a clinical, pedobarographic and gait analysis study." Foot Ankle Int23(6): 496-502.

Erdil M, NM Elmadag, G Polat, N. Tuncer, K. Bilsel, V. Ucan, O. F. Erkocak, C. Sen (2013). "Comparison of arthrodesis, resurfacing hemiarthroplasty, and total joint replacement in the treatment of advanced hallux rigidus." J Foot Ankle Surg52(5): 588-593.

Ess P, M. Hamalainen, J. Leppilahti (2002). "Non-constrained titanium-polyethylene total endoprosthesis in the treatment of hallux rigidus. A prospective clinical 2-year follow-up study." Scand J Surg91(2): 202-207.

Giannini S, F. Ceccarelli, C. Faldini, R. Bevoni, G. Grandi, F. Vannini (2004). "What's new in surgical options for hallux rigidus?" J Bone Joint Surg Am86-A Suppl 2: 72-83.

Grady JF, TM. Axe, EJ. Zager, LA Sheldon (2002). "A retrospective analysis of 772 patients with hallux limitus." J Am Podiatr Med Assoc92(2): 102-108.

Hamilton WG, MJ. O'Malley, FM Thompson, PE Kovatis (1997). "Roger Mann Award 1995. Capsular interposition arthroplasty for severe hallux rigidus." Foot Ankle Int18(2): 68-70.

Hasselman CT, Shields N (2008). "Resurfacing of the first metatarsal head in the treatment of hallux rigidus." Techn Foot Ankle Surg7: 31-40.

Kennedy JG, FY Chow, J. Dines, M. Gardner, WH Bohne (2006). "Outcomes after interposition arthroplasty for treatment of hallux rigidus." Clin Orthop Relat Res445: 210-215.

Koenig RD, LR Horwitz (1996). "The Biomet Total Toe System utilizing the Koenig score: a five-year review." J Foot Ankle Surg35(1): 23-26.

Konkel KF, AG Menger, SA Retzlaff (2008). "Mid-term results of Futura hemi-great toe implants." Foot Ankle Int29(8): 831-837.

Konkel KF, AG Menger, SA Retzlaff (2009). "Results of metallic Hemi-Great Toe Implant for Grade III and early Grade IV hallux rigidus." Foot Ankle Int30(7): 653-660.

Maffulli N, R Papalia, A. Palumbo A. Del Buono, V. Denaro (2011). "Quantitative review of operative management of hallux rigidus." Br Med Bull98: 75-98.

McGraw IW, SS Jameson, CS Kumar (2010). "Mid-term results of the Moje Hallux MP joint replacement." Foot Ankle Int31(7): 592-599.

Miller SD (2004). "Interposition Resection Arthroplasty for Hallux Rigidus." 3(3): 158-164.

Mulier T, A. Steenwerckx, E. Thienpont, W. Sioen, K. D. Hoore, L. Peeraer and G. Dereymaeker (1999). "Results after cheilectomy in athletes with hallux rigidus." Foot Ankle Int20(4): 232-237.

Park YH, JH Jung, SH Kang, GW Choi, HJ Kim (2019). "Implant Arthroplasty versus Arthrodesis for the Treatment of Advanced Hallux Rigidus: A Meta-analysis of Comparative Studies." J Foot Ankle Surg58(1): 137-143.

Pulavarti RS, JL McVie, CJ Tulloch (2005). "First metatarsophalangeal joint replacement using the bio-action great toe implant: intermediate results." Foot Ankle Int26(12): 1033-1037.

Swanson AB, RM Lumsden, GD Swanson (1979). "Silicone implant arthroplasty of the great toe. A review of single stem and flexible hinge implants." Clin Orthop Relat Res(142): 30-43.