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Revision hip arthroplasty using impacted allograft bone and cement

Studies on prosthetic stability and outcome

Vasileios Zampelis

DOCTORAL DISSERTATION
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Abstract

The clinical success of primary hip arthroplasty is paramount. Even so, in Sweden almost 10% of all primary hip arthroplasties will undergo revision surgery, mostly due to aseptic loosening. During the process of implant loosening, some of the bone in the acetabulum and/or femur is lost. One method of handling bone loss has been impaction bone grafting (IBG), in which allograft bone is morselized and impacted into the defects before the prosthetic components are inserted. Mechanically, the allograft bone immediately contributes to prosthetic stability. Biologically, the graft triggers a response that eventually leads to at least partial replacement of the allograft bone graft with new living bone.

The hypothesis in paper I was that long-term continious migration of the Exeter stem in hip revision with IBG and a cemented Exeter stem would eventually result in prosthetic loosening. Seventeen patients with Exeter stems were followed with radiostereometric examinations (RSA) annually for 9 years. The findings showed that migration of the stem continued over 9 years without clinical deterioration or radiological loosening.

The hypothesis in paper II was that the use of a bone substitute would increase tissue integration and thus achieve more stable prosthetic fixation. In an experimental tibia prosthesis rabbit model, 16 rabbits were used. The tibia prostheses were implanted bilaterally, one side with the prosthesis alone and the other side with the prosthesis and bone substitute. We found that early prosthesis-bone interface strength was not influenced by the bone substitute. However, during remodeling, the bone substitute might provide improved mechanical support for the prosthesis.

The hypothesis in paper III was that a disease-specific patient-reported outcome measure would perform better than generic measures in patients undergoing revision hip arthroplasty.The study compared the responsiveness of the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), SF-36, EQ-5D, and a pain visual analog scale (VAS) in 45 patients who completed the measures at baseline and 2 years after revision. The results showed equally high responsiveness for the WOMAC and the simple VAS for pain, with the EQ-5D showing the lowest responsiveness.

The hypothesis in paper IV was that by adding a bisphospshonate (clodronate) into the allograft bone, resorption of the allograft would be delayed, resulting in increased prosthetic stability and bone density. Eighteen patients with aseptic cup loosening underwent revision with IBG and a cemented Exeter cup and were randomized and double-blinded to either clodronate or saline (control group) as local adjunct to the morselized bone. The patients were evaluated with dual-energy X-ray absorptiometry (DEXA) during the first year regarding periacetabular bone density, and with RSA for up to 2 years regarding cup migration. Less proximal cup migration was found in the clodronate group up to 2 years. There was no significant difference in bone mineral density measured by DEXA. Thus, local treatment of the allograft bone with clodronate reduced proximal migration of the cup, but without any measurable difference in periacetabular bone density.

Overall, in this thesis we found that hip revisions with IBG and cement resulted in good clinical, radiological, and patient-assessed outcomes. We found an effect of the bisphosphonate clodronate on implant micromotion but not on bone density, and that use of a bone graft substitute in a rabbit knee model had a possible effect on the prosthesis-bone interface without having any adverse effects.

Key words: Arthroplasty, revision hip, bone impaction, morselized allograft, cement, radiostereometry

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Ιθάκη

"Σα βγεις στον πηγαιμό για την Ιθάκη,
να εύχεσαι νάναι μακρύς ο δρόμος,
γεμάτος περιπέτειες, γεμάτος γνώσεις.
Τους Λαιστρυγόνας και τους Κύκλωπας,
τον θυμωμένο Ποσειδώνα μη φοβάσαι,
τέτοια στον δρόμο σου ποτέ σου δεν θα βρεις,
αν μέν' η σκέψις σου υψηλή, αν εκλεκτή
συγκίνησις το πνεύμα και το σώμα σου αγγίζει.
Τους Λαιστρυγόνας και τους Κύκλωπας,
τον άγριο Ποσειδώνα δεν θα συναντήσεις,
αν δεν τους κουβανείς μες στην ψυχή σου,
αν η ψυχή σου δεν τους στήνει εμπρός σου.

Να εύχεσαι νάναι μακρύς ο δρόμος.
Πολλά τα καλοκαιρινά πρωιά να είναι
που με τι ευχαρίστησι, με τι χαρά
θα μπαίνεις σε λιμένας πρωτοειδωμένους·
να σταματήσεις σ' εμπορεία Φοινικικά,
και τες καλές πραγμάτειες ν' αποκτήσεις,
σεντέφια και κοράλλια, κεχριμπάρια κ' έβενους,
και ηδονικά μυρωδικά κάθε λογής,
όσο μπορείς πιο άφθονα ηδονικά μυρωδικά·
σε πόλεις Αιγυπτιακές πολλές να πας,
να μάθεις και να μάθεις απ' τους σπουδασμένους.

Πάντα στον νου σου νάχεις την Ιθάκη.
Το φθάσιμον εκεί είν' ο προορισμός σου.
Αλλά μη βιάζεις το ταξείδι διόλου.
Καλλίτερα χρόνια πολλά να διαρκέσει·
και γέρος πια ν' αράξεις στο νησί,
πλούσιος με όσα κέρδισες στον δρόμο,
μη προσδοκώντας πλούτη να σε δώσει η Ιθάκη.

Η Ιθάκη σ' έδωσε τ' ωραίο ταξείδι.
Χωρίς αυτήν δεν θάβγαινες στον δρόμο.
Άλλα δεν έχει να σε δώσει πια.

Κι αν πτωχική την βρεις, η Ιθάκη δεν σε γέλασε.
Έτσι σοφός που έγινες, με τόση πείρα,
ήδη θα το κατάλαβες η Ιθάκες τι σημαίνουν"

Κωνσταντινος Π. Καβαφης (1911)

Ithaca

"When you set out on your journey to Ithaca,
pray that the road is long,
full of adventure, full of knowledge.
The Lestrygonians and the Cyclops,
the angry Poseidon -- do not fear them:
You will never find such as these on your path,
if your thoughts remain lofty, if a fine
emotion touches your spirit and your body.
The Lestrygonians and the Cyclops,
the fierce Poseidon you will never encounter,
if you do not carry them within your soul,
if your soul does not set them up before you.

Pray that the road is long.
That the summer mornings are many, when,
with such pleasure, with such joy
you will enter ports seen for the first time;
stop at Phoenician markets,
and purchase fine merchandise,
mother-of-pearl and coral, amber and ebony,
and sensual perfumes of all kinds,
as many sensual perfumes as you can;
visit many Egyptian cities,
to learn and learn from scholars.

Always keep Ithaca in your mind.
To arrive there is your ultimate goal.
But do not hurry the voyage at all.
It is better to let it last for many years;
and to anchor at the island when you are old,
rich with all you have gained on the way,
not expecting that Ithaca will offer you riches.

Ithaca has given you the beautiful voyage.
Without her you would have never set out on the road.
She has nothing more to give you.

And if you find her poor, Ithaca has not deceived you.
Wise as you have become, with so much experience,
you must already have understood what Ithaca means.

Constantine P. Cavafy (1911)